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New Series, Vol. IX
Old Series, Vol. XXVIII | *Chicago* | FEBRUARY, 1913 | *New York* | No. 2

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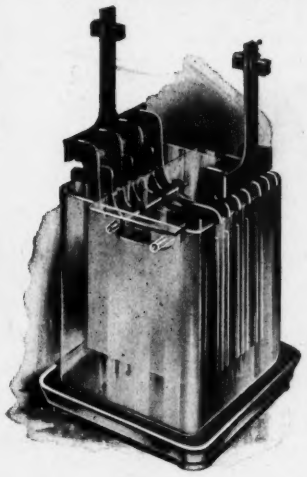

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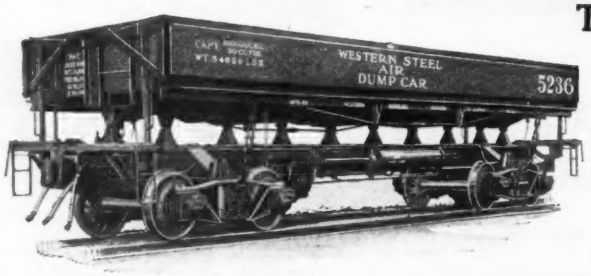

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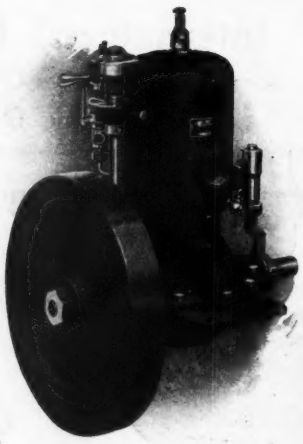

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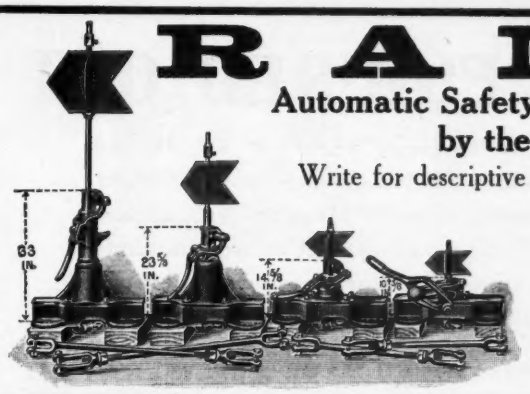

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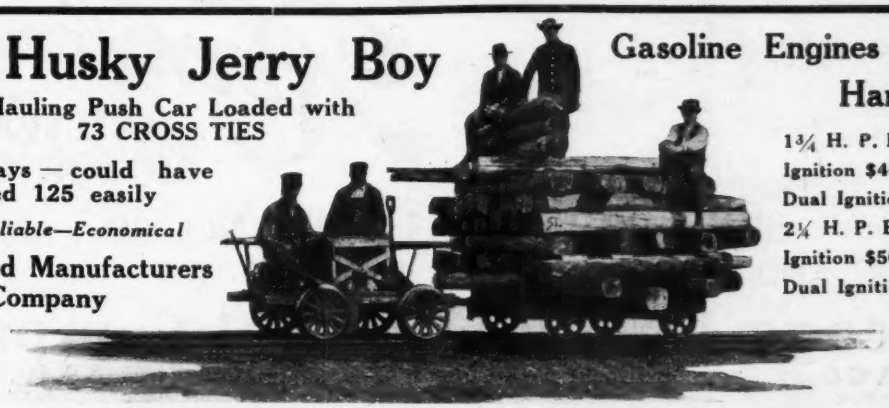

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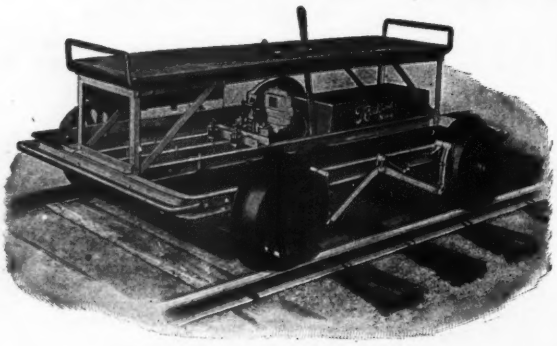

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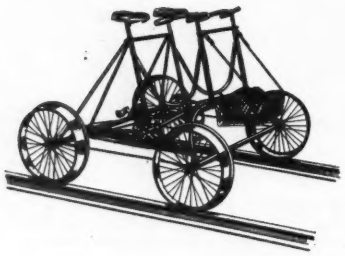

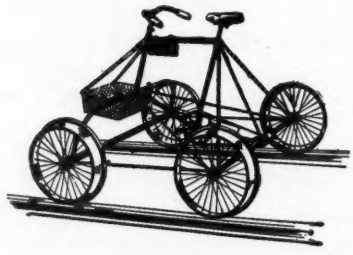

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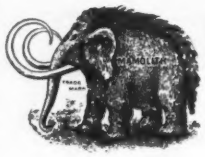

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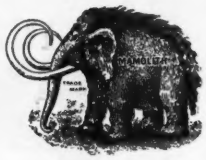

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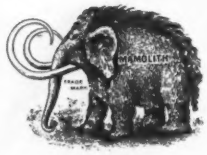

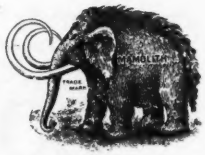

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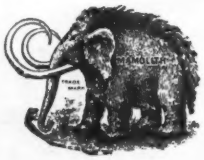

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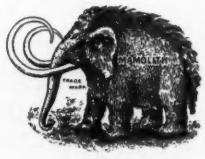

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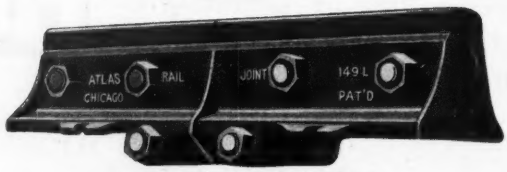

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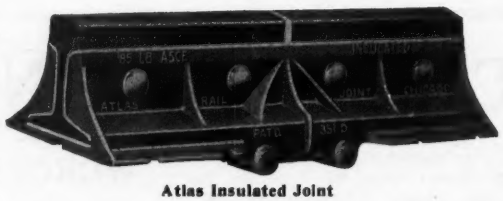

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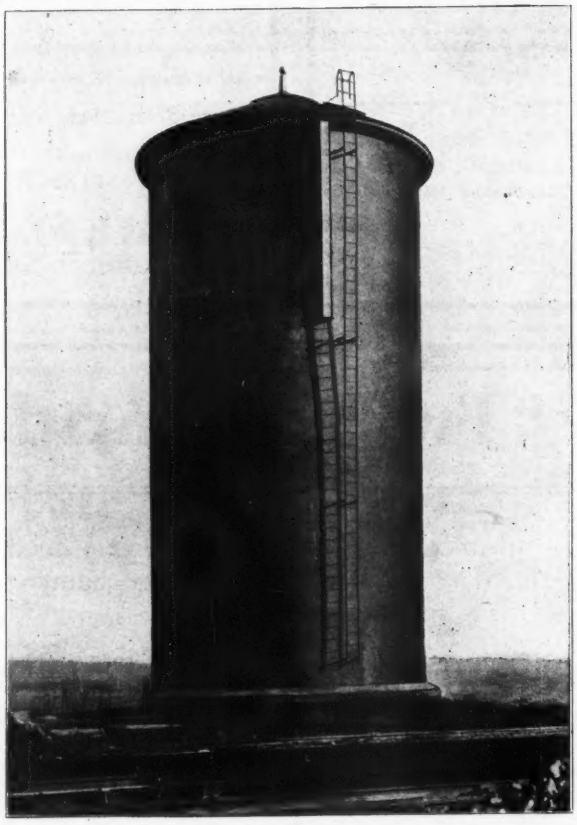

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Wood Preservers' Association

THE ANNUAL convention of the American Wood Preservers' Association was by far the most profitable one in its history. The Association has shown a remarkable growth in numbers, in work accomplished, and in prestige since its inception eight years ago.

Aside from the valuable papers submitted, of which there was an unusually large number, one other action of this convention marks an important step forward—the appointment of standing committees for the investigation of vital subjects, the preparation of specifications, etc.

The credit for the best convention ever held by this association is due to the untiring work and interest of the officers, especially E. A. Sterling, president, F. J. Angier, secretary, and J. T. Logan, chairman of the entertainment committee.

Promotions

PROMOTIONS made within the last year or so will give many engineers and others food for thought. A general broadening out is to be noticed in all departments of railway work, and the results of this new movement are bound to be beneficial. We refer especially to those railways having departmental organizations, i. e., railways where, on each division, the responsibilities are divided up among several different heads, each, in the main, independent of the others. The superintendent is usually, under this organization, the most powerful division official.

It used to be the rule that only those working directly in the operating department were thought to have any chance of advancement into the highest executive offices. This was natural, as the general managers usually came up through the operating department and were inclined to favor men of that department. Another reason why these higher offices were not open to other than operating officials, is that all railway men were inclined, under such a departmental organization, to specialize to an excessive extent, and in many cases even to hold a marked prejudice against the other departments. They were unlikely to attempt to familiarize themselves with the problems and work of the other departments.

The last few years show that a surprising number of officials of the engineering departments have been chosen for high operating department positions, and this tendency is steadily increasing. In reading the autobiographies of operating officials, it is seen that many of these men started originally in the engineering departments, but early in their career, changed over to the operating department, as it appeared to possess the greater opportunities.

The tendency to throw open the doors of the highest positions to any capable man has been fostered by those men who are broad minded enough not to be prejudiced because of a closer relationship and sympathy with a certain phase of railway work. Such a policy will make it more worth while for any man of exceptional ability to continue in railway work.

The removal of any discrimination which exists against any studious and capable man will make him a better and more faithful man in his work. Such a policy is bound to de-

crease and finally annihilate the departmental jealousy and distrust which has produced much friction in the past.

St. Louis Southwestern Freight Station

SEVERAL difficult engineering problems were worked out in the St. Louis Southwestern Freight Station at St. Louis, described on another page of this issue. The difference in elevation of the tracks on opposite sides of the layout was the most serious problem to be met, in order to prevent a heavy grade on the ladder tracks, which would make switching difficult; also to guard against a sharp down grade on the stub tracks, which would also require much care in switching and increase the danger of running over the stub ends or breaking the bumping posts. A grade on yard tracks would also be serious if cars are occasionally moved by hand.

The track layout takes advantage of the entire space available by using double parallel ladders running diagonally through the rectangle, at such an angle that the yard tracks run off parallel to the sides of the rectangle without curves behind the frogs.

Concrete has not been used in freight stations to any great extent, but it would seem to fulfill many requirements for this purpose, especially where there are warerooms, as in the St. Louis station.

Block Signal Location

FROM THE standpoint of the signal engineer the fundamental considerations in the location of block signals are, of course, length of block and economical installation, while considerations of gradient and curvature follow in importance. On the other hand, officers of the operating and mechanical departments are primarily interested in the considerations naturally given second place by those of the signal department, as above mentioned. There have been complaints from those who are responsible for locomotive operation, that the location of block signals is not always such as to make it possible to haul rated tonnage trains without considerable trouble and waste of time. So many considerations aside from the necessity for certain limits in spacing enter the problems of the signal engineer that it is not surprising when objections are registered by the operating department to certain locations selected. In level country the spacing of automatic signals is a simple matter, but in mountainous country the frequency of curves and grades calls for the most careful consideration in signal locating.

In the case of some recent installations of automatic block systems, the signals have been located on heavily ascending gradients, when it would seem that they could have been placed at the summits. At other points the nature of the country is such that the signals are placed directly at the entrances of tunnels and curves. Of course, the major consideration in such cases is the necessity for unobscured vision, but in many instances better results could be obtained if the signals were so located as to allow of unobscured vision for only a few hundred feet. In hauling the rated tonnage over a division, engine failures and delays often occur when the trains are blocked at points where starting is difficult. In the cases where the signals are located at tunnel entrances, it is sometimes impossible to get the trains through the tunnels without violating rules which forbid firing within the tunnel zones. It has sometimes been necessary to make exceptions to the rules governing the procedure of train crews at certain signals on account of the embarrassment resulting from a full stop in obedience to the general rules.

It is possible that at the time of installation a more careful consideration of the problems of heavy freight train operation would result in a more generally desirable location of block signals. Certainly the avoidance of any possible condition, which makes it necessary for a train crew to either take chances in running a stop signal or in stalling the train, is to be desired.

Retaining Wall Design

IN THE March issue will appear the first instalment of a series of articles on the design of concrete retaining walls, both plain gravity and reinforced. This subject will be treated in a most complete manner with illustrations of and diagrams for the design of various types of walls. Under the subject of reinforced concrete walls the best methods of placing reinforcement to take care of the various stresses will be discussed. An economic study of the different types of walls will be given in conclusion. These articles should be of value to the designing engineer because the aim is to clear up the inconsistencies and the incompleteness of the data on retaining walls heretofore published. This will not be merely a compilation of existing data, but an exhaustive study by an engineer who has had experience in this line of work both in this country and Europe.

Annual Convention, American Railway Engineering Association

The annual convention of the Railway Engineering Association will be held at the Congress hotel, Chicago, opening on Tuesday, March 18, at 10:00 a. m.

Reports from practically all committees will be presented to the convention for action. It is expected that the attendance will exceed that of previous years.

The convention proper will adjourn Thursday evening, March 20, the board of direction having decided to devote March 21 to a visit by the Association as a whole to the exhibit of the National Railway Appliances Association at the Coliseum and Armory.

An innovation will be introduced in the form of a reception to be given by the president and board of direction to the members, ladies and guests. This reception will be held in the Gold room of the Congress hotel, Tuesday evening, March 18. Wednesday evening, March 19, the annual banquet will be held in the same room. The names of the speakers at the banquet have not as yet been announced.

The Orange Northwestern has begun work at Vinton grading the extension, which when complete, will give this road a line with southern terminals at deep water in Orange, Tex., and to the north will extend as far as Natchitoches and probably Shreveport, La.

American Wood Preservers' Association

REPORT OF ANNUAL CONVENTION.

The ninth annual convention of the American Wood Preservers' Association was held at Hotel Sherman, Chicago, January 21 to 23 inclusive.

The officers for the year 1912 were: President, E. A. Sterling, consulting timber engineer; first vice-president, A. M. Smith, Ayer & Lord Tie Co.; second vice-president, H. M. Rollins, Gulfport Creosoting Co.; third vice-president, G. B. Shipley, Pittsburgh Wood Preserving Co.; secretary and treasurer, F. J. Angier, superintendent timber preservation, B. & O. R. R.

E. A. Sterling gave the opening address, in which he dwelt on the shortage of creosote and the possibility of a 10 per cent import duty being placed on creosote. He mentioned steps he had taken to prevent such action and recommended further action by the association on this subject. He also recommended the appointment of standing committees to take up the more important problems before the association.

The secretary's report showed a gain of 53 new members during the year, a gain of over 50 per cent.

A. E. LARKIN,
Gen'l Supt., Republic Creosoting Co.,
President, Wood Preservers' Ass'n.

J. H. WATERMAN,
Supt. Timb. Pres., C., B. & Q. R. R.,
First Vice-President.

F. J. ANGIER,
Supt. Timb. Pres., B. & O. R. R.
Secretary-Treasurer.

A Comparison of Zinc Chloride with Coal-Tar Creosote for Preserving Cross-Ties.

By Howard F. Weiss.

Although a great many preservatives have been tested to preserve cross-ties, zinc chloride and coal-tar creosote are now by far the ones most extensively used in the United States. Only cross-ties are considered in this paper, and the data which follow should not be confused with poles, piling or other products.

According to statistics gathered by the federal government, the number of cross-ties treated with zinc chloride in the United States shows no increase in the past four years, while the number treated with creosote has increased rapidly.

The factors which I have considered in comparing the two preservatives under discussion may be grouped as follows:

(1) The toxicity of the preservative—namely, its ability to prevent decay.

(2) The ability of the preservative to penetrate the tie.

(3) The permanency of the preservative in the tie.

(4) The effect of the preservative on the strength of the tie.

(5) The effect of the preservative on the corrosion of spikes and plates, and the operation of block signals.

(6) The financial saving due to the use of the preservative.

Of somewhat lesser importance are:

(7) The uniformity in composition of the preservative and ease of securing it.

(8) The combustibility of the preservative.

(9) The ease of handling the preservative and tie treated with it.

(10) The ease with which the penetration of the preservative can be determined.

Toxicity of the Preservative.

Zinc chloride relies upon its toxic properties solely to protect ties from decay. Creosote, in addition to this, has a more or less waterproofing effect, which also acts as a protection against decay. According to the toxic tests made by Malenkovic, zinc chloride offered about twice the resistance to fungous attack (penicillium) as coal-tar creosote free from phenol. Tests made at the Forest Products Laboratory showed that ordinary coal-tar creosote had about the same toxicity as zinc chloride, four-tenths per cent being sufficient in each case to prevent fungous growth (Fomes annosus).

The Ability of the Preservative to Penetrate Wood During Treatment.

In the author's opinion, this is a feature of tie preservation which is given, in practice, too little consideration; both zinc chloride and coal-tar creosote are powerful fungicides, and small quantities of them will inhibit decay. It is good practice, therefore, to diffuse the preservatives thoroughly through the tie so that as many of the wood cells as possible will be poisoned. A tie might contain ten or twelve pounds of creosote per cubic foot and yet be not nearly as well preserved as a tie having only four or five pounds of the oil per cubic foot, but with the oil uniformly and deeply distributed.

It is well known that water solutions will penetrate wood

more easily and thoroughly than oils; for example, in making what are caled the "penetrance tests" at the Forest Products Laboratory it took about three minutes to force zinc chloride solutions through 6 inches of hemlock parallel to the grain, while creosote took over 30 minutes. Any process which aims to impregnate ties with only a certain amount of preservative irrespective of the penetration secured is, in the author's opinion, operated on an incorrect basis.

The Permanency of the Preservative in the Tie.

Permanency, as applied to preservation, involves two phenomena: (a) volatilization; (b) leaching.

Zinc chloride under conditions of use is non-volatile. Creosote, on the other hand, evaporates from the tie. The rate at which it evaporates depends on many conditions, such as its composition, method of injection, atmospheric conditions during seasoning, etc.

E. B. FULKS,
Chemist, American Creosoting Co.,
Second Vice-President.

This objection to creosote has led in some cases to the use of tar as an adulterant, the idea being that such a mixture will withhold in the tie the more volatile constituents of the oil. It is quite probable that tar will do this, but there are strong objections to such practice, and it is the author's opinion that its adoption should take place only after much more convincing data than now have been obtained.

Creosote is practically insoluble in water, while zinc chloride is readily soluble.

From tests made in the Forest Products Laboratory it appears that certain amounts of zinc chloride can not be leached out of wood even by very severe soaking. It is claimed that the leaching of zinc chloride in ties can be retarded by air-seasoning them after treatment, or by coating them with an oil.

Effect of the Preservative on the Strength of the Tie.

Tests made recently indicate that both preservatives weaken the wood, although, if properly injected the weakening thus caused is too small to be of practical importance.

The Effect of the Preservative on Corrosion of Spikes and Plates and the Operation of Block Signals.

Some pieces of flange steel of equal dimensions, weight and quality were immersed, respectively, in coal-tar creosote and a 6 per cent solution of zinc chloride for three weeks and constantly heated at 98° Centigrade. At the end of this time the steel in the creosote lost .0064 gram, while that in zinc chloride solution lost 1.4636 grams. Of course this was a very severe test, not comparable to what takes place in the track; but even at atmospheric temperatures the corrosion of steel spikes and plates in contact with zinc-treated ties is probably greater than with creosoted ties. The consensus of opinion among those who claim experience seems to be that if the zinc ties are properly seasoned before placement in the track the corrosion is of no appreciable consequence.

The presence of zinc chloride in wood is very liable to decrease the resistance of the tie to the passage of an electric current. This action may, however, take place in untreated ties, especially when wet. Zinc chloride, being deliquescent, tends to keep the ties moist, while creosote tends to waterproof them; hence deterioration of spikes subject to the passage of electric currents is more likely to take place in ties treated with zinc chloride than in those treated with creosote.

GEORGE E. REX,
Manager, Treat. Plants, A., T. & S. F. Ry.,
Third Vice-President.

Mr. J. T. Butterfield, of Purdue University, made accurate tests on this subject in 1910. His tests concluded that ties treated with creosote offer greater resistance than those treated with zinc chloride, and less resistance than untreated ties.

The experiences of several signal engineers are that zinc-treated ties will cause trouble with the block signals if they are placed in the track unseasoned, or if the distance between blocks is too long.

Financial Saving Due to the Use of the Preservatives.

A discussion of all factors finally simmers down to a discussion of cost. Because of the scarcity of authentic service records generalities must still be used.

From actual figures it may be deduced that both preservatives are very economical to use in comparison with untreated ties, and of the two, creosote is ultimately slightly cheaper. Under the assumptions here taken zinc-treated ties must last about 12½ years in order to have the same annual charge as creosoted ties, while the creosoted ties must last 15½ years in order to have the same annual charge as the zinc-treated ties.

Uniformity in the Composition of the Preservative and Ease of Securing It.

The zinc chloride produced in the United States is, for a commercial product, extremely uniform in its composition and the quality can be readily duplicated and obtained. Creosote, on the other hand, varies considerably in its composition, and is not easily secured in satisfactory grades.

The Combustibility of the Preservative.

Zinc chloride is non-inflammable; creosote is inflammable; hence a zinc chloride plant presents a lower fire risk than a creosote plant. Zinc chloride-treated ties can be considered more fire resistant than untreated ties.

Ease of Handling the Preservative and Ties Treated With It.

Zinc chloride solutions can be readily handled at much lower temperatures than coal-tar creosote and do not present the many difficulties of heating that accompany the operation of creosote plants; on the other hand, they cause a great plant depreciation, due to their corrosive action.

Ease With Which the Preservative Can Be Tested and Analyzed in the Tie.

The presence of creosote in the ties can be detected more readily than the presence of zinc chloride; and, inasmuch as a knowledge of the depth of penetration is highly important, creosoted ties are much easier to examine. A chemical analysis of the treated ties is not feasible for daily use, so that the best method of detecting the depth of penetation in zinc-treated ties is to cut a section and apply chemicals to produce color changes, or to heat the freshly-cut section in an oven above the boiling point of water. However, a careful inspection of the treating plant and process is worth as much, if not more, than a critical examination of a few ties.

Summary of Results.

All the factors discussed will show that there are good grounds for hesitating in the selection of a preservative to be used in treating ties, and that the conditions peculiar to each road, or even parts of the same road, should affect such a decision. No sweeping generality can have much practical significance. The more noteworthy points brought out by this study are at present:

(1) Zinc chloride and coal-tar creosote, when used under normal conditions, are both effective preservatives of cross-ties, and there is little choice between them so far as annual charges are concerned.

(2) Creosoted ties in general cost initially more than Burnettized ties, the cost of treatment being from about 2 to 3 times as great.

(3) Creosoted ties last, on an average longer in the track than Burnettized ties, hence require less frequent renewals and changes in the roadbed.

Discussion.

E. B. Fulks.—The evaporation of creosote seriously affects only the surface of the ice. A tie in the track has only one side exposed to the air, while tests are always made with all sides of specimen exposed. Tar retards evaporation.

W. F. Goltra.—I think crude oil should be given a place in this comparison. From statistics which I have collected I find that the life we can expect from a tie with 22 lbs. of creosote injected, is only ten years. This fact would show a decided advantage for zinc chloride.

Walter Buehler.—Experience has shown ties treated with petroleum are immune against decay, but when they dry out they lose this property.

G. E. Rex.—We have some crude oil treated ties which were treated in 1901. Out of fourteen, two have decayed up to the present. This fact seems to show crude oil has not the necessary antiseptic qualities.

H. F. Weiss.—I do not think we should use tar in creosote until it has been fully tested. It collects on the surface of ties and makes them difficult to handle.

The Production and Supply of Coal Tar Creosote.

By E. A. Sterling.

Coal tar creosote is an anomaly among by-products because the demand is increasing faster than the output; and, since creosote is not made for itself alone, but is a resultant, constituting a minor percentage of coal tar distillation carried on to recover other products, the production is not gauged to the requirements of the consumer.

In 1912 the consumption of creosote in the United States on the basis of the average 7½ per cent increase of the previous four years, exceeded 78,000,000 gallons, of which about three-fourths was imported. In the same year R. P. Perry* estimated that 165,000,000 gallons of coke oven and gas works tar would be produced, and an additional 375,000,000 gallons go to waste in beehive coke ovens. The tar actually produced would have yielded, if distilled to hard pitch, approximately 50,000,000 gallons of creosote; while the tar which was not even recovered would have given us another 112,000,000 gallons, or a theoretical grand total of 162,000,000 gallons. The first 50,000,000 gallons includes the water gas creosote derivable from part of the gas works tar, the amount being indeterminable; but it will be near enough and serve the purpose to reduce the total figure by 12,000,000 gallons to a round 150,000,000 gallons.

We thus have, if our home resources were fully utilized, a potential creosote supply nearly double our present requirements. Actually we are producing only about 15 per cent of our potential creosote supply, and are drawing on the European market for the balance.

From the wood-preserving standpoint the fundamental necessity is to procure enough oil, at a cost which will encourage treatment, to keep our creosote plants running and provide for new plants.

The available supply of creosote obviously depends first on the amount of coal tar produced, and, secondly, on the manner and completeness with which it is distilled.

Gas works tar is produced in many of the larger cities, and while the use of electricity for lighting and the manufacture of petroleum gas tends to keep down the output of gas works coal tar, indications are that the present output will remain fairly constant, or, if anything, increase.

Coke oven tar is the largest source of creosote and it is mainly in this kind of tar that we may look for an increased output. It is stated that during 1912 new by-product ovens went into operation which have a capacity of 35,000,000 gallons of tar per annum.

The refining of coal tar in the United States has developed along different lines than in Europe. A fundamental handicap in this country until recently has been the lack of a market for the pitch, which is the largest constituent. Gradually the soft and medium pitch came into use for roofing papers, road binders, paving block filler and other purposes; while more recently the hard pitch has been in demand as a binder for briquettes, for electric carbons, and cast carbon forms of many kinds. The lighter oils, such as benzol, naptha, touol, crude carbolic acid, etc., find various uses, while the heavy oils constitute the creosote for wood-preserving purposes. At the present time our distillers are devoting fully as much time to the quantity and quality of creosote as our friends on the other side.

It is probably in the manufacture of the more refined coal tar products that domestic developments will be most tardy, for as yet it has not been profitable to compete against Europe in the production of colors, perfumes, extracts and the numerous and varied oils and compounds derivable from coal tar. On the other hand, we are far ahead of European distillers in our knowledge of roofing and waterproof pitches and road binders. Tar cannot profitably be distilled for the production of creosote alone, so there must first be an incentive to recover the more valuable products, or a sure market for pitch before what we are interested in can be produced.

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*From paper on "Tar Distillation in the United States," presented at the Eighth International Congress of Applied Chemistry.

An increasing use of refined tar for road purposes and of crude tar for fuel would increase the production of creosote. On the other hand, the increasing demand for disinfectants, which can be made from tar, and the growing use and higher value of the middle and heavy oils used for wood-preserving purposes, may be expected to counteract the tendency toward the use of crude or refined tar.

Despite the promising outlook in the domestic situation as regards an increased tar and creosote output, we have not for five years purchased from Europe less than sixty-nine per cent of our requirements, and in 1909 we procured seventy-three per cent of our oil from abroad. In fact, since the wood-preserving industry came into its own, we have been largely dependent on foreign creosote. European developments, therefore, as regards creosote supply are likely to remain for some time the determining factor in the matter of quantity and price of the oil needed by American consumers.

The most definite conclusions we can draw from a limited survey of the foreign field is that Europe will be in position to continue the export of large quantities of creosote, but that the increasing demand and the various developments in the coal tar industry promise to strengthen prices, and in some cases materially reduce the supply available for export.

The procuring of an adequate supply of creosote at reasonable cost may be safely considered a vital factor in the wood-preserving industry in the United States. With comparatively few large sources of production, and most of these east of Chicago, rail freights figure strongly in the delivered cost.

Up to a year or two ago it is not likely that railroads or commercial treating companies were often deterred from building plants by uncertainty as to their oil supply. Plant construction for a time went ahead at a rapid rate on the assumption that the creosote supply would take care of itself, which it largely did. It may do the same in the future and the indications are favorable, but at the present time it would be unwise to start a large development without looking into the situation very carefully.

There is very little which wood preservers can do about the question of creosote supply. They can, however, do considerable in the matter of consumption. First of all, it would no doubt help both the domestic and foreign producers in meeting the requirements, if the consumers would anticipate their needs as far ahead as possible. Crude oil, water gas creosote, and refined tar in mixture with creosote will bear further investigation as substitutes, while blast furnace oil, of which some of the English roads are using considerable quantities, should be tested out further. Crude oil is being given a thorough trial by the Santa Fe Railway.

Water gas or oil tar creosote has not received general recognition as a wood preservative and investigations have demonstrated that it lacks the high antiseptic qualities of coal tar creosote, yet it is not unlikely that it will eventually be used. The most rational way of using it, in the light of our present knowledge, would be to add a comparatively small percentage of it to coal tar creosote for the purpose of cheapening the latter.

It would also be profitable to look closely into our treating methods and eliminate excess injections of oil where it is reasonably certain, because of mechanical wear or for other reasons, that the lighter treatments would be sufficient. Even a 10 per cent economy in the use of creosote throughout the country would go a long way towards keeping within the limits of supply.

There was little discussion on this paper.

Notes on Analysis and Testing of Coal Tar Creosote.

By L. B. Shipley, Barrett Mfg. Co.

The object of the distillation tests of oil was to compare those methods which would embrace the various types of distillation. The three methods chosen are in their essential features comprehensive of practically all the methods extant, and by slight modification of the minor details of any of these three methods practically any known method can be secured.

1. American Railway Engineering Association.
   Retort method, described in Bulletin 65 of the Association.
2. National Electric Light Association.
   Report of Committee on Preservative Treatment of Poles and Crossarms, 1911.
3. Forest Service of the Department of Agriculture.
   Described by Dean & Bateman, Circular 112, "Analysis and Grading of Creosotes."

The results attained showed that the retort method and that of the N. E. L. Association give approximately the same results, while the Forest Service method gives considerably more distillate at 200 degrees, 210 degrees and 235 degrees than do the others, a result which might be expected.

Comparative Volatility of Oils.

The distillation range of three oils was investigated and also the evaporative loss of each oil from North Carolina pine blocks 3 inches square and ⅜ of an inch thick for a period of 28 weeks as well as the evaporative loss of the same oils exposed for a like period of time in open dishes. The relative evaporative loss of each oil from the open dish and from the treated wood was comparable. These results are of value only as an indication of relative volatility. The next logical step, and one which we are now arranging to carry out, is to make use of an experimental cylinder for a similar series of tests, and thus closely approximate conditions which are met with in practice.

Extraction of Oil from Treated Wood.

The object of these tests was to subject piles to a treatment in an experimental cylinder, using various kinds of oils, and subsequently to examine these piles and oils under varying conditions. Through the courtesy of the United States Wood Preserving Company, at Norfolk, Va., we were able to proceed with this work. Piles and one-foot sections of a given pile were there treated in an experimental cylinder during April, 1912. In November, 1910, six months after treatment, during which time the sections were exposed to laboratory conditions in gunny sacks, they were quartered, and alternate quarters reduced to fine sawdust by means of a circular rip-saw. The oil was extracted with benzol in an extraction apparatus and the benzol then removed by distillation up to 210° C., with the thermometer bulb in the liquid. Following is a tabulation of the results and a comparison with the original oils.

Oils used:
1. Coal tar creosote.
2. Coal tar creosote.
3. Oil tar distillate.
4. Oil tar distillate.
5. 50% No. 1 and 50% No. 3.
6. Paving oil.

The writer would draw from the results the following conclusions:

The specific gravities increased by evaporation in all cases except No. 6.

The tar acids do not appear to have evaporated any faster than the other portions of the oil.

The distillation tests are interesting as showing the relative evaporation of the oils.

The extraction of an oil apparently gives a fair index of its original character.

Some Experimental Treatments, with Reference to the Effect of Initial Air Pressure on Penetration of Creosote.

By R. S. Belcher.

Six experimental runs were made on the effect of initial

air pressure on penetration. Sawn and hewn longleaf, and loblolly pine ties were used, all the ties having been seasoned five months.

It was one of the objects of these test runs to ascertain the absorption and penetration of two runs having the same differential; that is, one having, say, 75 lbs. oil pressure and no initial air pressure at all, and the other having 100 lbs. air pressure, and 175 lbs. oil pressure, the excess of oil pressure over air being the same in both cases.

Runs 1 and 2 illustrate this: No. 1 having 100 lbs. oil pressure pumped on the ties with no air pressure to oppose it except the air naturally in the wood cells, the average absorption of this run being 54.60 lbs. per tie, or 16.72 lbs. per cubic foot, while Run No. 2 had 75 lbs. air pressure to oppose 175 lbs. of oil pressure and an absorption of 21.15 lbs. per tie, or 6.56 lbs. per cubic foot.

The penetration of the ties in Run No. 1 and 2, as shown in sections sawed from each of the ties, 18 inches from the end, allowing for the difference in amount of heart wood in the various ties, is very near equal in the two runs.

Runs 3 and 4 showed the same thing on sawed pine ties, having a much greater percentage of heart wood. The excess of oil pressure over air pressure in these two runs was 75 instead of 100 lbs. as in Runs 1 and 2. Run 3 had an initial air pressure of 100 lbs. and an oil pressure of 175 lbs., while Run 4 had no initial air pressure and 75 lbs. oil pressure. It was noticed that the absorption in Run 3 averages 9.10 lbs. per tie, and 3.37 lbs. per cubic foot, while in Run 4 the absorption is 20.50 lbs. per tie and 7.68 lbs. per cubic foot.

Run 5 had the same treatment as Run 2, namely, 75 lbs. air pressure and 175 lbs. creosote oil pressure. The absorption on this run averaged 11.30 lbs. per tie and 4.24 lbs. per cu. ft., being less than the absorption of Run 2 on account of the ties treated being heart ties, whereas Run 2 is composed of sap ties. The excess of oil pressure over air pressure in Run 5 was 100 lbs. while only 75 lbs. in Run 3.

The object in Run No. 6 was to see how quickly 5 lbs. per cubic foot could be put into the ties and what kind of penetration would be secured; no initial air to be used. When sufficient creosote had been pumped from the measuring tank to give 5 lbs. per cubic foot the treatment was stopped. This took exactly five minutes from the time cylinder was filled, and the pressure had gone up to 100 lbs. The cylinder was then immediately drained and a vacuum drawn to dry the ties. This run had an absorption of 15.60 lbs. of creosote per tie or 5.13 lbs. per cubic foot. The penetration with the minimum quantity of oil was very uneven and the sap wood was not entirely treated.

As a summary to these experimental runs then, it would seem that while initial air pressure lowers the amount of creosote absorbed by the timber, it interferes with the penetration very slightly, if at all, thus securing the maximum penetration with the minimum quantity of oil, and that the benefit derived from initial air pressure is greater proportionally on timber with a larger percentage of sap wood than on timber which is mostly heart wood. This being the case, it would follow that best results can be expected in so far as maximum penetration with small amounts of oil is concerned, by using reasonably high oil pressures, and keeping the air pressures as high as is possible, and yet leave in the timber the required amount of creosote.

Discussion.

B. Kuckuk.—It is not so much a question of penetration as of distribution, and the only way to get perfect distribution is by treatment to refusal.

J. B. Card.—After about two weeks have elapsed in the empty cell process, the penetration shows less than just after treatment.

G. B. Shipley.—We get better penetration and distribution with an initial air pressure. The air pressure should be varied with the different woods to obtain best results.

The Requirements for Successful Timber Treatment.

By Herman von Schrenk.

Treated timber has been used in the United States for a sufficient number of years so that we are beginning to obtain some results. As is the case in every other industry, some failures are becoming evident in various parts of the country. During the last year I have spent a good deal of time investigating the reasons for failures of pieces of so-called treated timber. I say so-called treated timber advisedly.

In the early days of timber treatment there was a good deal of experimenting as to methods, and, for that matter, there is still some experimenting, but as the result of some twenty years' experience some facts are sufficiently well known at the present time to all of us and these facts have become more or less axiomatic. Briefly stated, in order to get good results from treated timber the following points must be observed:

1. Only perfectly sound timber should be treated.
2. In order to obtain the best results, properly seasoned material should be used.
3. A good preservative is essential to long life.
4. Proper injection as to quantity and penetration is essential.
5. Proper subsequent handling of the timber is essential.

In my investigations I have found that the premature failures of so-called treated timber were almost without exception due to the non-observance of one or more of the above principles. I am perfectly sure that in the early days a good deal of timber was treated which was sap rotten. It was not realized ten years ago, as it is today, that timber may be very badly decayed in the interior and yet show absolutely no evidence on the outside. Many of the failures were, however, due to the fact that timber was treated because of certain contract requirements and in spite of a better knowledge of the person responsible for the actual treatment.

While there is no doubt very general agreement among the men engaged in the timber-preserving industry as to the fundamental conditions enumerated above, we all know that, under stress of business circumstances, they are not always adhered to. The consumer frequently makes demands which cannot be fulfilled, or if they are fulfilled are bound to result in speedy and ultimate failure.

The inspection of material before treatment should be made with greater care. I believe that every treating company should be empowered to refuse to treat material which is known to be defective. In other words, I do not think that anyone is warranted, under any circumstances, to treat material which he knows to be unfit because of various defects. A defective stick was never improved by any kind of treatment.

The same holds true for improperly seasoned material. The excuse is frequently given, in demanding treatment of absolutely green material, that emergencies have arisen which necessitate such treatment, or some similar explanation is given. Unfortunately, with the increased use of timber in its various forms, the tendency to require and do such rush work seems to me to be increasing.

That which has been said for the inspection of the material before treatment holds equally for the preservative used and the manner of treatment. How much service do you suppose will be obtained by treating green red oak ties with two gallons of creosote oil by the full-cell process? We all know that the penetration of timber so treated is insignificant and that internal sap rot is bound to occur in comparatively short periods of time.

I have no hesitation, however, in saying that I believe

it to be the duty of the man who knows how timber should be treated (because that is his business) to protest vigorously against any requirements which necessitate his treating a customer's material in a manner which he knows to be wrong. I wish to protest against the tendency which requires the actual treating operation to be conducted in accordance with any demands which may be made by the customer. The people as a whole are apt to forget that when the piece of so-called treated material fails, that that particular piece of material was treated under unusual conditions, no matter how much these conditions may have been justified at the time. I wish to protest against the "necessity" tendency to do rush work. We might as well face the problem now and say that successful treatment of timber can only be accomplished by observing certain laws, and that when one or more of these laws are broken, the consequences will be swift and certain.

I would favor the passage of some resolution emphasizing the necessity for a careful observance of the principles referred to. I am sure that a strong statement coming from this representative organization would be of the greatest service in giving a proper appreciation of what wood-preserving industry as a whole stands for.

Discussion.

C. G. Crawford.—I think that this paper takes a very good stand. If timber is in good condition it takes treatment much easier.

J. H. Waterman.—I would like to emphasize the point about treating only perfectly sound ties. One trouble experienced is that some plants have no control over the tie inspectors.

J. B. Card.—I favor air seasoning all ties received green at plant, and think air seasoning cheaper than steaming.

J. T. Logan.—We only steam season the larger timbers.

The Preliminary Treatment of Timber to Insure a More Even and Satisfactory Impregnation with Creosote.

By David Allerton.

It was brought forcibly to my attention last spring, although it has long been a subject of study with me, to find a method of accounting for the great disparity often noticed, and in fact usually observed in the receptivity of various ties or timbers in a given charge. Mr. Goltra, in his work, has shown graphically the various degrees of absorption in a charge of ties as usually treated; of course there will always, under any condition, be a considerable variation in a charge of carefully selected and sound ties, but is there not possible some method of preliminary treatment by which, without impairing the strength of the wood, the structure of the ties or timbers can be rendered more homogeneous so that with a given amount of oil the penetration will be more uniform?

Of course, heat is a necessity in any mode of procedure, and the proper temperature and regulation will undoubtedly be the most important factor in solving this problem, as it is well known that to get good results from hot oil with cold wood is impossible (bear in mind I am not speaking of soft pine or other soft woods that take treatment under any conditions). But here arises another question. Suppose the oil is dropped on the cold wood at a temperature of 180° F. and the heat in the cylinder again raised to 180°, how far into that wood is the temperature 180 degrees? That, of course, depends on the diameter of the pieces. With large dimension timbers it is a very little ways, unless a long time has been consumed, and even then the center of the wood is very much cooler than the outside. This is one reason why large timbers such as 12 inch by 12 inch, or 12 inch by 14 inch, are very hard to treat. Taking this into consideration, I think the next most important factor will be air in conjunction with the heat in current, or compressed moist or dry, and perhaps attenuated by more or less vacuum, as the situation will be found to demand, and in all probability the process will be varied somewhat for different species.

I assume that all will agree that the better seasoned the great majority of wood is, the easier and more satisfactorily it can be treated, therefore I also assume that a preliminary treatment can be found and very likely some of you have discovered the means by which, with the necessary adjuncts to the treating cylinder, or in accessory and less expensive cylinders, valuable time can be saved and the wood can be prepared to accomplish the best results.

The Treatment and Care of Floors.

By Geo. W. Saums.

Everybody needs floors, and therefore as a matter of fact the care and preservation of floors is in reality a large subject and worthy, it has always seemed to me, of more attention.

Wood used for flooring has no different characteristics from wood used for any other purpose, and is subject to precisely the same rotting conditions as when used for heavier work. Composition floors are rapidly being substituted for wood, especially where any heavy wear is likely, even though these compositions can never be as entirely satisfactory as a good wood floor, if that floor could only be preserved in good condition for a reasonable length of time.

Obviously, in addition to rot, it is necessary in floors to consider splintering and buckling, and it does not require a combination of two or more of these difficulties to make is necessary to relay a floor. Upon the appearance of any one of them a new floor must be laid.

Maple is first in favor for flooring, and is most frequently used. It is, however, also most expensive, and in some respects the most unsatisfactory floor. Irrespective of quality, however, maple is desirable for indoor floors chiefly on account of its good appearance, long wearing and non-splintering qualities, due to the close fibre of the wood. On account of extreme sensibility to dampness maple is seldom used for outside flooring.

Ash, oak and chestnut will all quickly splinter, if subjected to any heavy wear.

Pine, second only to maple in the extent of its use for floors, is perhaps the cheapest and least expensive to maintain, and can be used where traffic is heavy, and as it rarely becomes buckled, offering better resistance to weather conditions, can, aside from the matter of appearance, be used for floors where none of the other woods would do so well.

Pine, however, will splinter, and after commencing the splintering advances rapidly, making the cleaning of the floor almost impossible, and very quickly rendering it unsafe for traffic.

The desirability of treatment for floors to prevent splintering, rotting and buckling has, of course, been recognized, and different ways have from time to time been tried, and in my experience most of these different ways have been not only unsuccessful, but many of them positively injurious.

Creosote and similar real preservative materials are not practical for the great majority of indoor floors for obvious reasons, and it would seem, if this field is to be covered, that it can only be through the medium of a material that is an actual preservative, that will cause the floor to which it is applied to resist dampness and splintering, and that can be applied to the floor either after it is laid, or at least applied to the flooring of the building at the place where it is to be laid.

Preservation of Lumber for Car Construction.

By J. H. Waterman, Supt. Timber Preservation, C., B. & Q. R. R. Co.

My observation leads me to make the statement that treating lumber with creosote for car construction will be neces-

sarily limited, on account of the fact that it is impossible to paint timber, or rather impractical, after it has been creosoted. Most roads in this country have a standard color for their cars, and they would not want to change that color to black in order to please the wood preservers of this country. If any road should desire to change their stock cars to a standard black, then the creosoted timber would be the ideal, for they would be permanently painted, providing the timber was framed before it was treated, and as they are used for taking stock to the market, which means the grave for the stock, why not advocate painting all the stock cars in this country black? It would be a good color, if it did not remind you of a funeral train as it went by.

So far we have treated only car sills and car decking.

To date we have treated a total of twenty-three runs of fir car sills.

We succeeded in getting an average absorption of 11.41 lbs. per cubic foot.

We have treated a total of thirty-nine runs of fir car decking.

We succeeded in getting an average absorption of 14.33 lbs. per cubic foot.

The Fir Car Sills.

In the sap wood we got a thorough penetration; in the hardwood not to exceed one inch all around.

In the car decking, when it was dry, it was thoroughly penetrated with creosote. I presume you all understand that car decking is 1¼ inches thick.

Our people feel that it is not only practical, but that it pays, to treat the car sills and car decking for stock cars. You all realize that it would be impractical to treat car decking for box cars on account of the odor. They could not be used for flour and many other lines of merchandise, which would absorb at least the odor from the wood if treated with creosote. We never can look for a very broad field to operate in so far as treating car lumber goes. However, I believe it is practical to treat car decking for stock cars and flat cars. For stock cars it also acts as a disinfectant, and from that point it would be not only practical, but, I believe, effective, and for roads that are using lumber for car sills, there is no question but what it would lengthen the life very materially. How much I am not able to say, for we have only practiced treating car sills and car decking for about one year.

All of our new stock cars now that we build with wooden sills we treat the sills and all of them we treat the decking.

Discussion.

G. B. Shipley.—I think an empty cell process or zinc chloride would be sufficient to make the wood last till destroyed by mechanical wear.

History of Wood Preservation.

By W. F. Goltra.

Numerous processes have been employed for the purpose of preventing the decay of wood from dampness, atmospheric action, or the destructive operation of animals and parasitic plants. The principle in nearly all has been the same, namely, the injection into the vessels of the wood of some material which, by combining with the albumen of the woody tissues, prevents the decomposition or gives it a poisonous character. Some processes advocated consist simply in external application of preservatives to the wood. Of these processes many of them would, no doubt, prove effective, provided they could be carefully and economically applied, but most of them have not survived either through cost of material, difficulties in their operation or their inefficiency.

Very little is known of preservative processes adopted in ancient times. Pliny observes that the ancients used garlic boiled in vinegar with considerable success, especially with reference to preserving timber from attacks by worms; he also states that oil of cedar will protect such timber annointed with it from worm and rottenness. Oil of cedar was used by the ancient Egyptians for preserving their mummies. Tar and linseed oil were also recommended.

The oldest of all artificial processes for the preservation of timber, and one used among most savage tribes, is charring the surface of wood that is to be inserted in the ground.

Very little is known of any preservative process previous to the year 1657. In that year Johann Glauber, the famous chemist of Carlstadt, Germany, experimented with vegetable pyroligneous acid, the wood having been first carbonized by the action of fire, then covered with a coating of tar and immersed in the acid. (Pyroligneous acid is obtained by the distillation of wood. It is an acetic acid, holding in solution oily impurities.) Since this period many processes have been tried.

In 1737 Mr. Emmerson patented a process of saturating timber with boiled oil mixed with poisonous substance; but this process was very little used.

About 1740 Mr. Reid proposed to arrest decay by means of a certain vegetable acid (probably pyroligneous acid). The method of using it was by simple immersion.

In 1756 Dr. Hales recommended that planks at the waterline of ships should be soaked in linseed oil to prevent the injury to which wood is subjected when alternately wet and dry; and, indeed, many ships were built in which a hollow place was cut in one end of each beam or stern-post which might constantly be filled with oil. Sometimes the tops of the ship masts were hollowed in the form of cups or basins and holes bored from the end to a considerable way down the masts and oil was poured into these cups and it was left to find its way down the capillary vessels to the interior of the timber.

Before the earliest of these dates, however, the preservative properties of solution of slack-lime and chloride of sodium, or common salts, were facts of common knowledge.

At the beginning of the Eighteenth Century a member of the Royal Academy of Stockholm called attention to the use of alum for preserving wood from fire, stating that wood or timber for the purpose of building may be secured against the action of fire by letting it remain for some time in water wherein vitriol, alum or any other salt has been dissolved which contains no inflammable parts. In 1815 Mr. Wade found that alum was not a good preservative and caused speedy decay of timber. In the same year Mr. Wade recommended the impregnation of timber with resinous or oleaginous substances (preferring linseed oil to whale oil), or with common resin dissolved in a tank of caustic alkali, and that the timber should afterwards be plunged into the water acidulated with any cheap acid or with alum in solution.

In 1811 Mr. Lukin undertook to treat wood by burying it in pulverized charcoal in a heated oven. He erected a large kiln in Woolwick Dockyard, but an explosion took place on the first trial before the process was completed, which proved fatal to eight of the workmen and wounded twelve. The experiment was not repeated.

In 1815 Mr. Ambrose Boydon, of the English Navy Office, strongly advocated that timber blocks and tree nails of ships should be first boiled in lime water and that they afterwards should be boiled in a thin solution of glue, by means of which the pores of the wood would be filled by a hard substance insoluble in water, which would not only give the timber durability, but would increase its strength.

In 1817 Mr. William Chapman published the results of several experiments he had made on wood with lime, soap and alkaline salts. He recommended the use of a sulphate of copper or blue vitriol.

In 1832 Mr. Oxford took out a patent for an improved

method of preventing decay of timber. The process proposed was as follows: "The essential oil of tar was first extracted by distillation and at the same time saturated with chlorine gas. Proportions of oxide of lead, carbonate of lime and carbon of purified coal tar were ground and were mixed with oil and the composition was then applied in thick coating to the substances intended to be preserved."

Active progress in timber preservation dates from the year 1832. During this year Mr. Kyan patented in England the process of corrosive sublimate, or bichloride of mercury, for preventing decay of timber. This process is usually called "Kyanizing," after the name of the inventor. It consists of steeping the wood in a solution of corrosive sublimate, the strength of which is usually one pound of salts to ninety-nine pounds of water. The work is usually performed in open masonry pits, without pressure, because of the corrosive effects of the chloride of mercury on metal. It is a very slow process compared with those in which the wood is impregnated under pressure.

In 1837, a Mr. Flockton invented a process for preventing decay by saturating timber with oil of tar and acetate of iron. But little is known of this invention; we believe it was a failure. During the same year Mr. Flockton's process was made known, a Frenchman named Letellier recommended saturating timber in a solution of corrosive sublimate and, when dry, in one of glue. During this year Mr. Margary took out his patent for applying sulphate of copper to wood. His patent, as well as Burnett's, taken out a year later, shows that the chemical was intended to be introduced into the wood by soaking, or immersion; but this practice was soon abandoned and injection by pressure substituted.

In 1838 Sir William Burnett, formerly director general of the Medical department of the English navy, made known to the public his new process for treating wood. The invention consists of destroying the tendencies of certain vegetable and animal substances to decay by submitting them to the action of chloride of zinc. At first the method of impregnation was by immersion in open tanks. In 1847 a powerful cylinder of Burnett's construction, hermetically closed, was laid down adjoining the saw-mills in Woolwich Dockyards. With this it was possible to treat large timbers and to apply a pressure as high as 140 pounds per square inch and extracting the moisture, by means of creating a vacuum, from the pores of the wood, which were afterwards filled with chloride of zinc. This process is usually called "Burnettizing," after the name of the inventor.

Modifications of zinc chloride processes have been proposed to correct the principal objection above mentioned. One of them is known as the B. M. process (Bruning-Marmetschke process for preserving wood, H. Bruning, manager, Schopfurth, Germany). The process consists of adding aluminum sulphate to zinc chloride, and it is claimed that zinc chloride salts are made more permanent in the wood.

We now arrive at the modern creosoting process, which was invented by Mr. John Bethell, of England, and patented by him in 1838. Mr. Bethell's patent relates more particularly to the method of treatment rather than the kind of preservative employed. This consists of the use of closed vessels that contained the timber, in which first a vacuum was produced, the timber being partially surrounded by the chemicals, and being preferably placed in an upright position; then fully surrounded by the chemical and pressure applied to force it into the wood.

Previous to the time of Mr. Bethell's invention practically all impregnation of wood was accomplished by immersion in open tanks or open boilers and in his method of injecting the material into the wood placed in cylinders, hermetically closed, by pressure, it may be said that he is the inventor of what is commonly known today as the pneumatic pressure process.

Among the many attempts to preserve woods, those processes discovered by Sir William Burnett and Mr. John Bethell, both Englishmen, have proved the most successful and upon which all of the subsequent methods and improvements in treating timber are founded.

A Frenchman named Breant patented his discovery in 1831. It was adopted to a considerable extent in France. Breant's apparatus consisted of a very ingenious machine, which, acting by pressure, caused liquids to penetrate into a mass of wood of large diameter and of considerable length. He may, therefore, be regarded as having solved the problem of penetration in a scientific, though not practical, manner.

In 1839 Mr. Boucherie, a Frenchman, patented his process, which consisted in causing a solution of sulphate of copper to penetrate to the interior of freshly cut woods to preserve them from decay. In this process the liquid is taken up by the tree, either whilst it is growing in the earth or immediately after it has been cut. This process is still in use in France for treatment of telegraph poles, and the method of impregnation is by hydrostatic pressure.

Mr. Blythe, of Bordeaux, France, patented a process of preparing wood by the injection of heated solutions of sulphate of copper, heated to nearly boiling point and placed in a lead cylinder, protected by wood. Mr. Blythe also invented another process called thermo-carbolization. This process consisted in treating wood with carburetted steam to extract the saps and water and at the same time inject it with creosote held in suspension.

In 1841 Mr. Payne patented his invention. The materials employed in Mr. Payne's process are sulphate of iron and sulphate of lime both held in solution with water. The timber is placed in a cylinder in which a vacuum is created; a solution of iron is then admitted into the vessel, the fluid being readily absorbed by the assistance of the vacuum. The sulphate of iron is then withdrawn and another solution of sulphate of lime is run into the cylinder, which enters the substance of the wood in the same manner as the former solution, and these solutions react upon each other and form new combinations—muriate of iron and muriate of lime.

Julius Rutger's Zinc-Creosote Process, patented in Germany in 1874, consists of four operations: (1) steaming the timber; (2) producing a vacuum and admitting the preservative fluid; (3) the application of the pressure pump, and (4) application of final vacuum to hasten drying of the material. The preservative is a mixture of creosote oil and zinc chloride. A modification of this process has been employed at several plants in the United States and is known as the Card process.

Mr. Samuel B. Boulton, of London, England, obtained a patent in 1879, for process of treating wood. He gets rid of the moisture in the timber simultaneously with the injection of creosote. The wood, either fresh or seasoned, being placed in the cylinder, creosote heated to over 212 degrees Fahr. (the boiling point of water) is admitted, and the air pump is used to exhaust any or all of the water thereby converted into steam, the theory being that the water is simultaneously replaced by warm creosote, which, of course, penetrates the wood more easily than would be the case at a lower temperature, the force pumps being also used if necessary.

While numerous experiments were going on in England, France and Germany to discover the best methods of treating woods, Americans were not idle. The most noted men in the development of the industry in this country are Mr. Octave Chanute, who designed and built several of the early plants and was interested in their operation for nearly twenty years; Mr. Samuel Rowe, who designed the pioneer treating plant at Los Vegas, New Mexico, and who wrote the first American book on Timber Preservation worthy of mention;

Mr. A. A. Robinson, who was Chief Engineer of the Santa Fe in 1885, after four years of experimental work, had works built in New Mexico; Mr. Julius Kruttschnitt, of the Southern Pacific, who built works at Houston, Texas, in 1891, and Mr. H. U. Mudge, now President of the Chicago, Rock Island & Pacific Railway, a notable student of wood preservation and one who has done much towards its development and improvement. Among the array of American inventors and practitioners, we make special mention of Seeley, Hayford, Hasselmann, Wellhouse, Isaacs, Curtis and Card. Mr. Seeley was granted a patent in 1867 on a method of impregnating, consisting of immersing the timber in an iron tank filled with oil, heating it to drive out the moisture, replacing the hot oil suddenly with cold oil, whereby it is forced into the wood by condensation. A patent to Hayford in 1872 added to the use of steam for seasoning, the pressure of hot air to prevent the checking of the timber by more rapid seasoning of the exterior portions of the wood. This method was advocated and followed by E. R. Andrews in his works at Boston. A patent to Messrs. W. G. Curtis and J. B. Isaacs, of the Southern Pacific Railroad, was granted in 1895, covering a process identical with Mr. S. B. Boulton's, except that they did not use the vacuum during the boiling. The philosophy of both is that water is vaporized at 212 degrees, while the oil does not vaporize under 365 degrees. A temperature maintained between these two will drive off the moisture of the water, which can be replaced by oil with pressure. Both of these methods have been used in this country with success.

The solutions containing metallic salts are more readily injected than oils, but they leach out, consequently it has been attempted to use them in conjunction, and various methods have been patented for this purpose. Mr. J. D. Card proposed a method of first injecting a small amount of tar oil, then immediately thereafter injecting a solution of zinc chloride. He claimed that by this means he secured a much better distribution of the oil in the wood than was possible with the ordinary injection of the same amount of oil and at the same time thoroughly protected the interior of the stick with zinc chloride. Mr. Card introduced the Wellhouse process on the Atchison, Topeka & Santa Fe at the Los Vegas, N. M., works built in 1885. This process consisted of the injection of zinc chloride, followed by injections of solutions of glue and tannin, the object of the two latter being to plug up the ducts of the timber by the artificial leather formed by the glue and tannin.

Another treatment used considerably in this country with zinc-creosote is the Allardyce process, which consists of an injection of a 2 per cent solution of zinc chloride into the wood, followed immediately by an injection of about three pounds of creosote oil per cubic foot. A number of ties treated this way by the International Creosoting & Construction Co., at Beaumont, Texas, were laid in the track in the year 1900, and a large percentage of them are still in the service at this date.

A second process of zinc-creosote, known as the Card process, was introduced in America a few years ago. It differs in the Allardyce in the fact that an emulsion of zinc chloride and creosote is made and forced into the wood in one operation.

Natural and Artificial Seasoning of Douglas Fir for Treatment.

By Mr. F. D. Beal.

Although we have been treating Douglas Fir for about twenty-four years, we cannot say that we have yet developed a method of seasoning that could be considered wholly successful under all conditions.

Our first move was to take up the steaming and vacuum process with which you are all more or less familiar, and the writer used to think they were vaporizing the wood itself by the looks of all the pitch, resin, etc., that used to come out through the drains.

This was carried on until the maximum vaporizing point was reached. A vacuum pump was then applied, heat being maintained in the cylinder by the circulation of superheated steam through steam heater pipes in the bottoms of the cylinders. This vacuum and superheated steam was carried on until the balance of the moisture, etc., was fully extracted from the cylinder. In this manner the wood would take the preservative under pressure very readily, but the strength of the material was so impaired as to practically condemn it for use in structures.

Various other schemes were then tried out with little success until in 1894 Mr. John D. Isaacs conceived the idea of trying out a modification of the "Boulton Method" of seasoning by immersion of the unseasoned timber in creosote oil, using the oil as a medium for conveying the heat to the timber, raising the temperature of the oil above the boiling point of water—thus vaporizing the moisture in the wood, allowing it to pass off through vent pipes into condensers through which cold water was circulated, but eliminating the use of any vacuum pump.

This method of seasoning has been carried on continuously on the Pacific Coast now for over twenty years, and although there is some decrease in strength, the material is in much better shape and lasts longer than that air seasoned or treated by steam.

At the present time experiments are being carried on at St. Helens, Ore., at the St. Helens Creosoting Co.'s plant, on the seasoning of ten thousand Douglas Fir ties. These experiments are being carried out under the direction of Mr. George E. Rex, of the Santa Fe. The ties were weighed, tagged and numbered, record being taken of the same. They were then placed in the water during the months of May and June, 1912. They were cribbed in cribs of about sixty ties to the crib, but instead of being cross piled in the cribs they were all laid one way, separately, with one-inch strips nailed to the ties, the reason for this being that it was desired to place the ties in running fresh water with the ties lengthwise up and down the stream, thus allowing the water to pass through the entire length of the ties.

These ties were left in the water until about September 15th, when they were taken out and the five thousand reweighed to ascertain the amount of water absorbed. They were then piled in open piles to air season. When it is found that the ties are sufficiently dry they will be treated by pressure process alone, without any artificial seasoning.

The object of these experiments is to try and find some process of seasoning without the application of heat in order to retain the natural strength of the wood as much as possible, the theory being that Douglas Fir when sawed into lumber and immediately piled in the open air, checks and splits excessively.

At the date of this writing, November 20th, 1912, the theory of eliminating the checking and splitting is working out admirably. The ties as yet show no evidence of splitting or checking in any manner.

The Treatment of Douglas Fir with Creosote Oil.

By G. A. Coleman.

It is well known that Douglas Fir is more difficult to treat than most eastern and southern pines. Two systems have survived, the time-honored Steam and Vacuum Process, refined and adapted to new conditions, and a new timber; and the Boiling Process, which is rather a step backward, being only the primitive open-tank method with the addition of pressure after the moisture has been boiled out. Good work can be done by the latter when conditions are ideal, but the great variety in the grain and density, and

condition of seasoning of timber, especially piling, when treated in commercial quantities, renders the work very irregular. So much so that from five to eight per cent of the treated material, in common practice, has to be returned for retreatment.

By the steaming process fairly uniform work can be obtained, as the effect of steaming is to render the timbers equal as to moisture, so that during the vacuum, the real drying period, the seasoning goes forward uniformly.

Sun baked or air seasoned timber, except it be first water seasoned, cannot be successfully treated by the boiling process, as no part of the treatment has any effect on that hardened condition characteristic of Douglas Fir.

Results show that piling taken directly from the boom to the retorts, after treatment by the boiling process, will frequently have a penetration of 1½ inches on the under, or wet, side, while the upper, or dry side, will have almost no penetration. The effect of steaming is somewhat similar to that of water seasoning. Early operators undoubtedly failed with the steaming process, because of plants poorly equipped with resources for maintaining adequate temperatures under the vacuum, without which it is impossible to season the timber properly, and attempted to make up the deficiency by excessive steaming, sometimes as long as twenty-four hours, which is far beyond the point of safety. There is a critical point somewhat beyond the time of being heated through, beyond which steaming should not be carried, and which must necessarily vary with the dimensions of the timber.

In conclusion, therefore, in the opinion of the writer, two points recommend the steaming process, uniformity of penetration and a minimum depreciation.

Efficient Handling of Ties and Materials at Treating Plants and Efficient Handling Ties for Seasoning.

By A. M. Smith.

For handling lumber and piling we use traveling cranes, as more than 95 per cent of this material comes to us and is loaded out in open cars. The machines we use have a lifting capacity of about one ton at a radius of 35 feet and can be used for light switching service when necessary. Our experience teaches us that switching with these machines should be avoided as much as possible. We use on the end of the hoisting or lifting line two pairs of hooks of suitable size for handling timbers and piling; a small pair for the piling with a spread of about 16 inches at the points and a large pair for timbers and boards that will open to 30 inches at the points. For very small pieces of lumber we use two slings made of round chain, and handle in quantities of about one-half to one ton weight.

In handling of piling, one piece at a time and for lengths up to 60 feet, we unload or load them at the rate of 200 to 400 per day with crew of five men to each machine. In handling lumber with same machine and crew, the cost is from 10 to 25 cents per thousand feet. We use six of these machines at our southern plants and frequently work part of them both day and night.

We have adopted the 1x9, or German style, of stacking our ties, as we believe the best results are obtained with this method of piling ties. If it is properly done there are continuous openings from the front to the back of the pile between each two layers of ties. This method also produces a minimum point of contact, one tie with another, throughout the entire pile, and half of the ties are inclined sufficient to drain off any water that may fall on them.

A seasoned tie is one that has sufficiently dried out to take the treatment specified for it, regardless of how long it has been seasoning, and should be treated at that time unless there is other material on the yard that is more liable to deteriorate.

Some Tests to Determine the Effect Upon Absorption and Penetration of Mixing Tar with Creosote.

By F. M. Bond, Forest Product Laboratory.

The author stated that the experiment had not been carried far enough to give conclusive data:

1. The following series of oils for each of the three tars were tested at a temperature of 160° F. and a pressure of 75 pounds per square inch for their relative absorptions and penetrations in two sets of matched specimens, using tar from which the free carbon had been extracted in each case:

Creosote. Per Cent of Total Oil by Volume.	Tar. Per Cent of Total Oil by Volume.
100	0
75	25
50	50
25	75
0	100

2. For each of the three tars there was tested at a temperature of 160° F. and a pressure of 75 pounds per square inch, a series of mixtures, each of which contained 50 per cent of creosote and 50 per cent of tar by volume, but different percentages of free carbon. Two sets of matched specimens were used in each series.

3. A series of mixtures, each consisting of 50 per cent of creosote and 50 per cent by volume of one of the tars containing the normal percentages of free carbon, or of one of the tars from which the free carbon had been removed, was tested at a temperature of 160° F. and a pressure of 75 pounds per square inch, using two sets of matched specimens. This series included, of course, mixtures of each of the carbon-free and the normal-free carbon tars.

Results.

Before discussing the results obtained in these experiments the writer wishes to emphasize a fundamental limitation that must be applied to the results of all tests upon wood, i. e., that, while data obtained under a given set of conditions upon well-matched specimens of wood are comparable, provided one condition only, whose result is unknown, be varied at a time, results from different sets of matched specimens are not necessarily comparable. Pieces of wood will behave differently when there is a variation in either the number of annual rings per inch, the ratio of the amounts of summer wood and spring wood, the amount of resin present, or a number of other characteristics.

Experiments upon specimens which are matched as described in this paper are in reality conducted at different points along the same piece of straight-grained wood, which is sawed into short lengths simply for ease of handling. There is, therefore, a minimum of the variability common between different pieces of wood. When the results of tests upon sets of matched specimens of diverse origin are compared, however, the variability between the wood of the two sets may be greater than the variations in the factor which is being examined, thus obscuring the results.

Tentative Conclusions.

The data which have been obtained in the experiments described in this paper seem to indicate at this time the following:

1. The difficulty of penetration into longleaf pine of mixtures of creosote and a given tar from which the carbon had been removed was in proportion to some direct function of the amount of tar in the mixture.

2. There was no apparent relation between the amounts of carbon-free tar in mixtures of creosote with the three tars and the corresponding absorptions and penetrations into longleaf pine.

3. There was no apparent relation between the viscosities and specific gravities of mixtures of creosote with the three

carbon-free tars and the corresponding absorptions and penetrations into longleaf pine.

4. The difficulty of penetration into longleaf pine of mixtures of equal parts of creosote and a given normal tar was in proportion to some direct function of the amount of free carbon in the mixture.

5. There was no apparent relation between the amounts of free carbon in mixtures of creosote with the three normal tars and the corresponding absorptions and penetrations into longleaf pine.

6. There was no apparent relation between the viscosities and specific gravities of mixtures of creosote with the three normal tars and the corresponding absorptions and penetrations into longleaf pine.

7. The free carbon appeared to occur in agglomerations of different sizes in the three tars.

8. There was no apparent penetration of the free carbon into longleaf pine.

9. The free carbon appeared to form mats of different degrees of density and imperviousness on the surfaces through which the oils entered the wood.

10. The tar producing the free carbon mat which appeared to be of great density and imperviousness was the tar in which the number of the smaller free carbon agglomerations appeared to be relatively greatest and was also the tar of which the normal amount of free carbon appeared to produce the greatest difference in penetration into longleaf pine, although this tar contained the smallest percentage of free carbon.

11. The tar producing the free carbon mat which appeared to be of least density and imperviousness was the tar in which the free carbon agglomerations appeared to be of greatest size, and was also the tar of which the normal amount of free carbon appeared to produce the least difference in penetration into longleaf pine, in spite of the fact that it contained the largest percentage of free carbon.

Discussion.

Extended written discussion was given on this discussion by S. R. Church and E. B. Fulks attacking the conclusions drawn, on account of insufficient tests, low temperature used, etc. W. M. Bond explained that the conclusions were not intended to be final.

Adzing and Boring Ties and the Cost of Installing Machines for This Purpose.

By James A. Lounsbury.

The folly of paying twenty to thirty-five cents each for chemical treatment of ties and then to so mutilate them by hand adzing and spike driving as to greatly reduce the beneficial effect of the treatment is too obvious to require argument.

Machine Adzing.

Of the 150,000,000 ties used annually in this country, approximatey 74 per cent are hewn and 26 per cent sawed. Hewed ties are never straight and the face side is never a plane surface. Sawed ties are straight when first made, but go into wind during seasoning. The consequence is that the rails when laid have an uneven bearing on the tie, throwing the weight of the supported load on a very restricted area of the rail base and introducing very serious stress factors into the rail problem. Hand adzing is resorted to commonly to correct the defects in the tie surface, but this is at best only a partial remedy, and its effect on the impregnated part of the tie is destructive. The advantage of having a full and perfect bearing for the rails over the whole width of the face of every tie is evident. It reduces rail cutting, decreases the danger of breaks in rail bases, reduces disturbance of the ballast and gives added firmness and stability to the track. Where plates are used it is a practical necessity to give them a full bearing on the ties, as the increased surface makes it more difficult for them to properly seat themselves under traffic. If their bearing on the tie is not parallel with the bottom of the rail they increase the danger of rail breakage, as they form an anvil upon which the impact of rapidly moving loads is received. If the point of support is along one edge of the rail base only, the danger to the rail is apparent.

Many tests made by the United States Bureau of Forestry, by several universities, and independently by a number of the railroads, have demonstrated conclusively that common square spikes have increased holding power when driven into previously bored holes.

The use of screw spikes, of course, makes pre-boring absolutely necessary. A number of roads are already committed to this form of rail fastening, and its extended use is only a matter of time. At present probably 75 per cent of the ties that are bored are for square spikes. The possession of a convenient means for cheaply and rapidly doing the boring will cause the early adoption of the screw spike on many roads which would be slow to take it up under other conditions.

Of chief interest, however, to the members of this Association is the great advantage from a treating standpoint of having the adzing and boring of ties done before the treatment takes place. The vital points of a tie are the parts under the rails and contiguous to the rail fastenings, and this is where the impregnation should be most thorough. In air seasoning the ties become case hardened on the outside, and this hard skin is more difficult of penetration than the portion immediately beneath. In adzing previous to treatment this more resistant portion is removed for a distance of 12 inches to 14 inches in length for each rail bearing. This permits the chemical to penetrate more freely transversely to the grain. The holes bored for the spikes give the chemical free entrance into the interior, allowing it to radiate from each hole by end grain penetration, thoroughly saturating these portions even when the tie as a whole is not given a heavy treatment. It is stated by the railroad engineers who have had several years' experience with adzed and bored ties that the saving in time and labor in putting the ties in track is sufficient to pay the cost of the adzing and boring, leaving all the other advantages a net gain.

The adzing and boring of ties has been standard practice in Europe for upwards of twenty years, and the results have proved its economy. Owing to the abundance of cheap labor in those countries, the development of machines of the highest labor-saving capacity has not been rapid. Their ties are more carefully made, and therefore machines are not required to meet such wide variations as in this country. In England the majority of ties are sawed from dimension stock and vary little in size. A range of 1½-inch difference in thickness is all that is provided for in their machines, while ours must be designed so that ties from 5 inches to 10 inches thick, and from 7 inches to 14 inches wide, may be run promiscuously. Again, their ties being practically of the same width, no provision need be made for centering, so that the holes will always be properly placed in the face of the ties. With our extreme variations in width, because no two ties are alike in shape, and because crooked and straight ties must follow each other through the machine, it is necessary that they be centered over the boring bits, so that the holes shall be accurately placed in relation to the center line of the face of each tie. In other words, the machine must take ties as they come, of all sizes and shapes, and automatically adjust itself to variations and irregularities, without human aid and without decrease in its rate of production.

Two distinct patterns of adzing and boring machines are built for different methods of mounting. One is designed

for installation on a stationary foundation, and the other, a more compact form, for mounting in a car. As more machines are specified for stationary mounting, this type is known as the Standard pattern. It is more open in design and accessible in its working parts than the more compact car type.

Does adzing and boring pay? It is believed that the increase in life that may be expected from ties adzed and bored before treatment will not be less than one-third, but to be conservative we will consider that it is only 15 per cent, or say 21 months of added service. In the case of a railroad using 1,000,000 ties a year, costing when treated, delivered and put in track 85 cents each, the total saving in tie renewals will amount to something over $100,000 a year. In comparison with the cost of equipment, is this not worth while?

Discussion.

G. E. Rex.—The use of adzing and boring machinery is the greatest step forward that has taken place in the maintenance of way department.

The Piecework or Unit System of Handling Ties and Timbers.

By W. W. Eldridge, General Piecework Inspector (State Department), Chicago, Burlington & Quincy Railroad.

The handling of ties and timbers on a "Piecework" or "Unit" basis is, I believe, not universally practiced in the timber-treating industry. Some plants follow the practice to a greater or lesser extent under one system or another.

The question arises, "What is the object of piecework, and what are the advantages to be derived therefrom?"

The object of piecework is to get one dollar's worth of labor for one dollar and to give one dollar for one dollar's worth of labor or, in other words, to increase the efficiency in handling ties and timbers to the maximum, so as to get the largest possible output at the least cost.

The advantages of the piecework system are numerous. In the first place it reduces by approximately one-third the number of men required to do the work, and hence makes a corresponding decrease in the amount of supervision needed.

It enables you to get the "cream" of the laborers to do your work. There is no place for the "drone" in the piecework system, as he will be pushed aside and eventually crowded out.

It systematizes the work and assists materially in the accounting, figuring costs, etc.

It places each individual workman in business for himself, and enables him to secure pay for what he does. Being paid for what he does, it is natural for him to combine mental ability with physical strength in order to accomplish all possible.

The installation of the "piecework system" is no small task. A great deal of tact and good judgment must be exercised, and unless it is established on good business principles, it will be a failure rather than a success. There are a good many things to be taken into consideration along this line.

First, be open and above board with your men in everything you do in connection with their work, as it is of the utmost importance that the men fully understand what you expect of them, and what they can expect of you in return. You must have confidence in your men and they in you to obtain the best results to all concerned. Every detail should be fully explained to them. The existence of doubt would be disastrous, and might be likened unto the little Toredo, which enters the piling unseen and slowly but persistently destroys life and tissue until nothing but the shell is left and the piling fails. Metaphorically speaking, you should so thoroughly impregnate the minds of your men with the antiseptic "piecework" that there would be no chance for the little Toredo "doubt" to gain entrance, to say nothing of existing, in your piling "the piecework system."

Second. Treat your laborers as men, and be fair and square with them at all times. Be ready and willing to counsel with them and explain any points that are not quite clear to them. My experience has been that there is a common feeling among men that in order to exist under the piecework system they must exert themselves unduly. This impression is erroneous, and you should disabuse their minds of the same. The man who starts out in the morning on a run to perform his work, regardless of method, does not accomplish the desired result, for the reason that he has set a pace that is not in keeping with his physical ability, and before the day is half done he is exhausted and compelled to quit. What is the result? The man is dissatisfied because he is disappointed with the results of his efforts, and he immediately condemns the system when, in fact, he should condemn his own lack of good judgment. In no case should a man be permitted to set such a pace, but rather strike a good even gait that he can maintain throughout the day, and by combining method and system he will be more than satisfied with the result.

Third. The selection of competent supervision, or foremen. A man to be a good foreman must be wide awake and energetic at all times. He should be familiar with every detail of the work assigned to him, as also the most practical way to handle ties and timbers so that he can impart it to his men. He should have a knowledge of handling men and be on the ground all the time. He should not be a slave driver, but should be firm and diplomatic in all his relations with his men. These men should understand that his word is law, but if for any reason they deem his demands unreasonable they should be at liberty to put the case up to the general foreman or other higher authority for final decision. In my opinion the superintendent or manager personally should make the final decision, if necessary to carry it that far.

Fourth. Care should be exercised in perfecting your organization to place your men to the best advantage, and to see that there are no more men in the gang than needed, and yet enough to handle the work without delay to other parts of the organization. You would not hitch a draft horse and a donkey to the same wagon and expect to get efficiency. This is a feature that should be considered in the personnel of your organization.

Fifth. Schedules should be made to cover each and every operation.

Sixth. In wording your schedules particular attention should be given to the phraseology to see that it is clear, concise and easy to understand, so there will be no chance for any dispute to creep in under the guise of a technicality, and last, but not least, cover all the work which you expect the men to perform under any schedule.

In handling ties and lumber of all kinds a distinction should be made between hard and soft wood as follows:

Oak or hardwood.

Pine or softwood.

This for the reason that pine or fir weighs approximately three pounds per foot, while oak weighs five pounds per foot. You would not expect any man to handle 5,000 pounds for the same price as 3,000 pounds.

Someone has said that the efficiency of a timber-treating plant should be based on the number of retort hours worked out of the total possible retort hours. In obtaining efficiency in plant operation the fact must not be lost sight of that good and effective treatment is the first or primary object, and at the same time your supervision, your organization, and your system of physical handling must be the best pos-

sible. This is what we claim to have under the "piecework system." During the year 1912 at our Galesburg plant we obtained on the above basis 98¾ per cent efficiency, or, in other words, each of the three retorts were in actual operation 98¾ per cent of the time. This means that out of a total of 7,488 possible retort hours for each retort they were operated 7,394.4 hours, holidays excluded.

Discussion.

Wm. A. Fisher.—We use piece work, negro labor, and save about one-half on cost of handling ties.

J. B. Berry.—Piece work is cheaper, better, and more satisfactory.

J. H. Waterman.—We handle everything by piece work. The only difficulty is that some official is liable to step in and want to reduce the rate, which should never be allowed. Make your rate right in the first place and stick to it.

Preparing Timber for Treatment in the Gulf States.

By R. L. Allardyce.

In ties I would require ninety days as a minimum and would prefer four months, the ties should be in open stack and I have found that better results can be obtained by stacking six or seven on two instead of on one as the German method calls for. The stacks should be at least three or four feet apart to allow the air to circulate freely as well as to give the bottoms of the alleyways a chance at the sunlight, otherwise you will find the bottoms of your stacks damp and moldy. In stacking on both sides of your tracks care should be taken that the stacks are directly opposite each other, making if possible a continuous alleyway across your yard as this would insure you a better circulation of air.

Ties that are loaded for treatment on damp days or in the early morning should have an initial vacuum of a half to one hour before treatment, as we have a very heavy dew to contend with at times; during this period of vacuum the closed steam coils should be used lightly to heat the ties to an even temperature; this would eliminate the dropping down your warm oil on cold ties.

In steam seasoning there is less capital tied up, the material is treated when received in the yard, and the cost of handling once is eliminated as ties do not have to be stacked in the yards; also you save interest on the purchase price of your material that is tied up for three or four months.

In heavy materials it is practically impossible to properly air season it. Take, for instance, caps or stringers of long leaf; leave them in stack for five or six months and unless you use S irons on them they will open up and the inspector will reject them on account of season checks. The cullage on this class of material is quite an item to commercial plants when the non-steaming method is used, for when the material is received at the plant it is up to specifications; six months later there are many culls on account of season checks.

In steaming, green material is all seasoned practically the same and will get a more even penetration throughout the load; in the non-steaming method some of the material will season out faster than others and in treating will absorb more of the preservative than required, while the slow seasoning pieces will not have the required amount in them. I have obtained good results from steaming and do not know of any disadvantages.

The operator should be governed by the sap drainage from his retort in regulating temperature. At times the sap will almost stop flowing and it will be necessary to raise the temperature a slight degree to facilitate this flow.

Most specifications have incorporated in them the maximum temperature allowed and I try to comply with them. As to the duration of the steaming period I could not advise any certain time, as the condition of the material, the amount of sap wood, the cross section and numerous other conditions would have to be considered, no two charges will be treated exactly alike for there will be differences in each individual charge, whether air seasoned or steamed.

Three papers on Wood Block Pavements were read as follows: "How Nearly Does the Modern Yellow Pine Block Pavement Approach the Ideal Pavement and What Improvement Can We Suggest?" H. L. Collier; "Timber for Creosoted Block Paving," H. G. Davis; "Laying Wood Block Pavement," H. S. Loud.

Thursday forenoon, Jan. 23, the convention was addressed by J. E. Rhodes, secretary-manager of the National Lumber Manufacturers' Association, and by George K. Smith, secretary of the Yellow Pine Manufacturers' Association.

Banquet.

A banquet was held at the Vogelsang Cafe at seven o'clock Wednesday evening at which the members had a very enjoyable time. A number of interesting talks were given, after which there was a program of musical numbers.

The election of officers Thursday afternoon resulted as follows:

President—A. E. Larkin, Mgr. Republic Creosoting Co.

1st Vice President—J. H. Waterman, Supt. Timb., Pres. C., B. & Q. R. R.

2nd Vice President—E. B. Fulks, American Creosoting Co.

3rd Vice President—Geo. E. Rex, Supt. Treat. Plants A., T. & S. F. Ry.

Secretary and Treasurer—F. J. Angier, Supt. Timb., Pres. B. & O. R. R.

CONCRETE IN RAILWAY WORK.*

By Frederick Auryansen, Bridge Engineer, Long Island R. R.

The reputation of concrete for railroad structures is based on the sure foundations of:

1. Low cost.
2. Speed of construction.
3. Permanence with increasing strength.
4. Adaptability.

The first extensive use of concrete on the Long Island was in the Atlantic Avenue improvement, begun in 1901, whereby grade crossings for several miles through the city of Brooklyn were eliminated. Several of the many uses to which concrete was put in this work are described in what follows.

Concrete Piles.

In 1912 about 500 16-in., 28-ft. piles, some rolled and some on the flat, were used to support the five 1,000-ft. platforms of the Jamaica station. These platforms being on a new fill of about 20 ft. to 25 ft. height, some unyielding supports were necessary to insure no settlement. Concrete piles were chosen because they were estimated to cost less than longitudinal walls, even with generous openings, but with footings spread to reduce the bearing pressure to a safe value.

Of the 300 octagonal piles used not one was broken either in handling or in driving, and many of them were made in rather cold weather. About 1,600 piles of various lengths are now under construction. As their cost is not over 50 cents per foot, ready to drive, they will probably be used hereafter instead of creosoted wooden piles where the permanent saturation of the ground is more or less uncertain.

Platform Construction.

The five concrete platforms now being built at Jamaica will each be 22 ft. wide and 1,000 ft. long, supported by bents of two concrete piles at 15-ft. intervals. The surface is inclined slightly from the center towards a line about 18 in. from the edge and from this low point a rise of ¾ in. to the

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*Abstract of a paper presented at the Pittsburgh meeting of the National Association of Cement Users.

edge of the platform is provided to prevent passengers from slipping toward the edge. The surface was checkered in 2-ft. squares to facilitate the escape of rain water and was indented with a spiked roller to avoid excessive smoothness.

Retaining Walls.

To avoid the expense of piles, reinforced concrete wall footings have been successfully used, extending them so that uniform pressures are obtained over the whole base. Where the soil is very yielding an important factor in the design of a wall is its weight, which is a minimum with the reinforced type; the very thin walls with buttresses have but slight additional advantage over a wall of 20 per cent section and the latter is a great deal easier to build. On most of the work gravity walls have been used, but the semi-reinforced section, using either old rails or large sized rods, is making a very favorable showing.

Coal Trestles.

The products of combustion of coal are injurious, as is coal itself, to both steel and wooden trestles, so that all new coal trestles on the Long Island have either concrete piers or the steel members are encased in concrete.

Fences.

One of the most satisfactory of small uses developed for concrete is its use in fences. Right-of-way posts, for instance, can be made at a cost of only about 45 cents apiece, which means that the cost of the fence per linear foot, spacing the posts 20 ft. apart, and using woven wire, is as little as 10 cents. A great deal of solid slab concrete fence is being used, spacing the posts, which are about 7 in. square, approximately 10 ft. apart and erecting a 3-in. slab between posts. Former practice has been to cast the posts in place and then the slabs, but it is difficult to hold the reinforcement in the middle of such a thin slab and at the same time get the concrete thoroughly into the forms. A contract involving 12,000 ft. of fence is now being executed. The slabs and posts are cast in molds on the ground, the slab rods being laid into the half-filled forms, which are then filled to the top. The post foundations will be accurately located, and will have cored holes to receive the rods extending from the bottom of the posts as dowels, the holes to be filled with grout before setting posts. The slabs will be erected at the same time as the posts, making a simple and complete operation,

Cattle Guards.

It has been found that triangular sections of reinforced concrete, 5 in. high and 8 ft. long, reinforced with three ¼-in. bars, make very satisfactory cattle guards. Niches are left in either edge about 6 in. apart so that one spike is sufficient to hold two adjacent guards. To prevent unsightly breakage, the ends are rounded off. These guards are giving better service than either the old wooden guards or the newer vitrified sections.

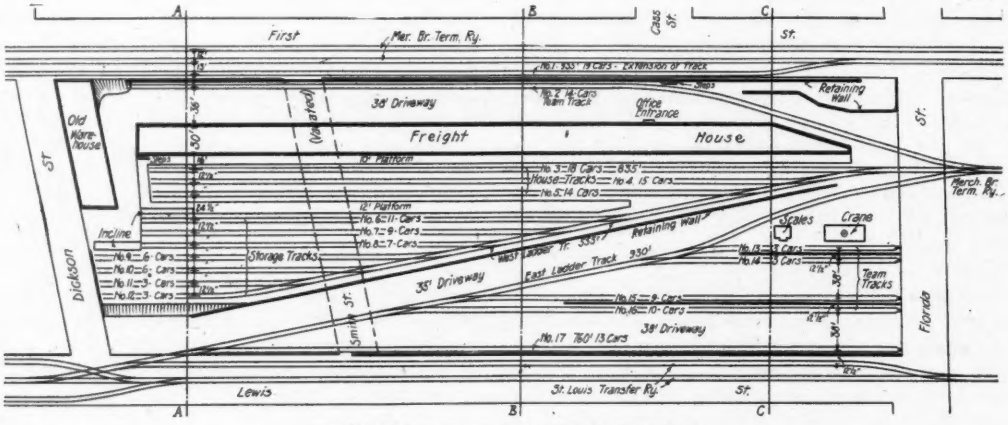
"COTTON BELT" FREIGHT TERMINAL AT SAINT LOUIS.

The increase in the volume of freight handled at St. Louis by the St. Louis Southwestern Ry., due to its expansion in Arkansas and Texas, and to the recent remarkable development of these states, has necessitated the building of a large new freight terminal to replace the present old and wholly inadequate facilities. Several extensions have recently been built in Arkansas and Texas into new territory, and with every prospect of as great a future ratio of development in the old territory served as in the past, it was the part of wisdom to make the new terminal ample for a large increase over present business, and to spare no expense in making it up to date and economical of operation.

The new terminal occupies three city blocks and lies between First and Lewis streets and Florida and Dickson streets. It is about 874 feet long and 274 feet wide. The main line tracks of the Terminal Railway Association leading from the Merchants bridge are on First street to the west of the property, and the tracks of the St. Louis Transfer Railway, which is a part of the Terminal Railway, are on Lewis street to the east. Lewis street is about 20 feet lower than First street and Florida and Dickson streets, at the north and south ends of the property respectively, slope down from First to Lewis street on a grade of 7 per cent. For the fullest utilization of the property, which had been bought at great expense, it was necessary in designing the yards to plan for a connection with the tracks both on First and on Lewis street. This involved a serious difficulty of design on account of the difference in elevation of these tracks and the steep slope of the property. The final arrangement was adopted as providing a maximum of convenience of operation with a minimum waste of space, and requiring no steep grades.

The principal features of the terminal are briefly: A freight house 751 feet long, 30 feet wide and five stories high; a yard of ten tracks to serve the freight house, and for the storage of cars; a transfer platform 500 feet long; and a team track yard of five tracks.

The difficulty of getting tracks into all four corners of a comparatively small rectangular area was overcome by running two ladder tracks diagonally through the property, from one of which the house and storage tracks lead toward the south and from the other of which the team tracks lead toward the north. Between these two tracks is a driveway diagonally from Florida street to Dickson street and connection with the ends of the driveways between the team tracks. In the team track yard the elevations of the tracks and driveways conform in general to the 7 per cent. slope, the various levels being divided by small retaining walls. The driveways of the team yard are paved with granite



Track Plan, Cotton Belt Freight Terminal.

blocks and have concrete curbs. Features of the team track yard are a wagon scale and a crane of 25 tons capacity mounted in the middle of the concrete platform.

Freight House.

The design of the freight house built was adopted in the belief that, though various systems of handling freight have been tried, such as telpherage systems, hoists, etc., nothing can surpass for economy the simple plan of trucking freight to or from the cars through a narrow building. Hence the building was made long for capacity and narrow for economy. The building is 751 feet long, 30 feet wide and has a platform on the track side 10 feet wide. On the west side is a driveway paved with brick. Kinnear steel rolling doors are provided on each side of the building and there is a 12-foot concrete canopy on each side. At short intervals along the middle of the building platform scales are set in the floor.

The building is five stories high and completely fireproof, being of steel frame construction with concrete fireproofing around columns and beams, and reinforced concrete walls, floors and roof slabs. The floors are designed for a load of 500 pounds per square foot, the panels between beam centers being 13 feet 6 inches.

The four upper stories are intended for warehouse purposes and are served by four electric elevators. This extension of the plan to include a large warehouse area without using any more ground space was warranted by the permanent demand which exists for such space in St. Louis and by the additional freight business which such a warehouse connection would naturally bring. Each floor is divided into compartments about 100 feet long, by division walls having openings 12 feet wide provided with rolling steel doors with automatic fire latch. The entire building is protected by an automatic sprinkler system.

Near the north end of the building, on the first floor, is a large and well finished office for the bill clerks and cashier, and above this, on the second floor, is a larger office for the freight agent and his clerical force. On the first and second floors are seven toilet rooms. These and the offices are heated by steam from a boiler located in the cellar in the north end of the building. The vacuum system is used. One compartment on the third floor is also heated—this to be used for a storeroom for fruit.

A refrigerator room is provided on the second floor of the two story building above the boiler cellar at the north end. The walls, floors and roof of this room are insulated with 3-inch cork slabs. Refrigeration through ammonia pipes is provided by the St. Louis Cold Storage & Refrigeration Company. This room is served by a special elevator.

In order to provide for the transferring of freight from car to car, a reinforced concrete platform about 500 feet long and 12 feet 6 inches wide has been built between the third and fourth tracks east of the freight house. This is connected with the building by a cross platform at the south end. A convenient feature is a concrete end loading incline at the end of one of the tracks, providing an ever-ready means of loading traction engines, threshing machines, boilers, fire trucks, automobiles, etc.

The floors are designed for a live load of 500 lbs. per square foot. The beams are concrete encased I-beams with a span of 13 ft. 6 ins. The slab is 10 ins. thick, reinforced with ¾-in. corrugated or deformed bars on 6½-in. centers, across the 13 ft. 6 in. span. Across the 30 ft. span ⅝-in. expansion bars are spaced on 24-in. centers.

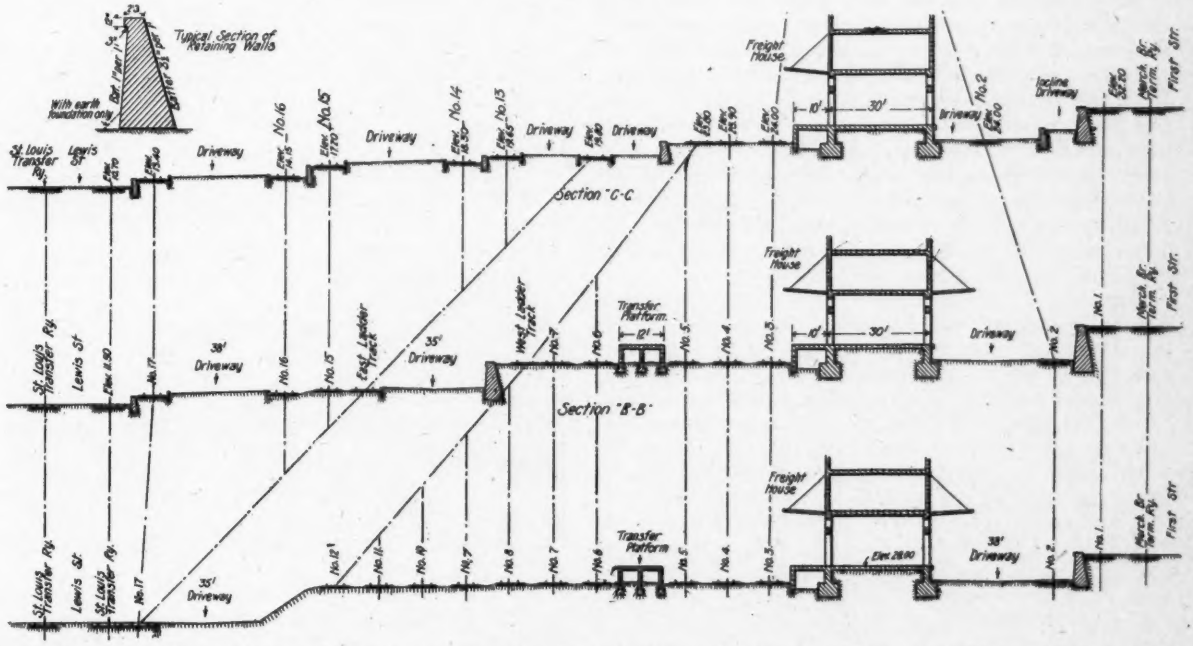
The roof slab is designed for a live load of 50 lbs. per square foot and is 4 ins. thick. The reinforcing consists of ⅜-in corrugated or deformed bars on 5-in. centers, with ⅜-in. expansion bars on 24-in. centers. The spans are the same as in the floors.

The platform is an 8-in. slab with ½-in. bars spaced on 7-in. centers, and ⅜-in. longitudinal expansion bars spaced on 24-in. centers. The effective reinforcing in all cases is that across the short span, the bars across the long span being expansion bars only. The roof was waterproofed with layers of tar and felt; gravel was placed on the top layer of tar while hot.

Each story has wooden floors nailed to wedge shaped nailing strips, embedded in a concrete filler.

The curtain walls are 8 ins. thick, reinforced horizontally and vertically with ⅜-in. square deformed bars on 12-in. centers, placed 4 ins. from face.

The concrete canopies, which appear in one of the illus-



Sections, St. Louis Freight Terminal. Dot and Dash Lines Showing Corresponding Track Centers in the Different Sections.

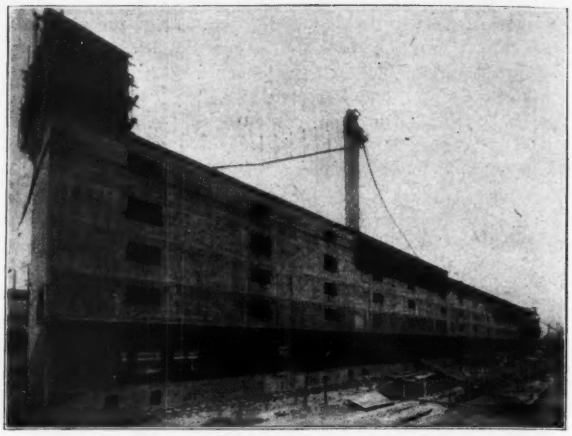
trations on each side of the freight house, are 4-in. slabs designed like the roof slabs. Steel bars, with turnbuckles, are located at 13 ft. 6 in. centers, supporting the canopies. They provide shelter for laborers unloading and loading cars, and for teams while loading and unloading wagons.

Architecturally the building is as pleasing in appearance as its massive design and utilitaran purpose warrant. The usually flat appearance of a concrete surface is relieved by verde-green terra cotta lion heads at the ends of the canopy rods, terra cotta shields at the corners, and a large terra cotta sign, all in verde-green.

The work of tearing down the old buildings of the Charter Oak Stove Company, from which the real estate was bought, was begun in September, 1911. Wrecking and grading were carried on during the fall. The severity of the winter prevented the accomplishment of much, except the erection of the steel frame. About 15,000 cu. yds. of concrete were used in the entire construction. The long and narrow form of the building lent itself admirably to economy in formwork. The outside wall forms were built in large panels 40 ft. 6 ins. long and one story high. The beam, floor and inside wall forms were built in small panels light enough to be handled by two men. The concrete was poured in sections including about one-quarter of one story. While one of these sections was being concreted, another was being erected by the carpenters. The form panels were moved to the next section and thus used over and over. The large outside panels were moved along the building and from story to story by a wooden traveler. which ran on rails temporarily placed on the steel roof beams. The form panels were suspended from the traveler by multiplying chain hoists.

There was a large quantity of stone in the old building which was wrecked, and a stone crusher was set up and this stone crushed for concrete. A tower and gravity chute system was used for distributing concrete. The tower was located about 250 ft. from the south end of the building. For the extreme north end of the building the distance was too great for the spouts, and in order to save moving the tower, dump cars were used to transport the concrete for about one-sixth of the building on the north end. The first floor was paved first, then the walls up to the second floor, then the second floor, etc. The walls between pilasters were curtain walls 8 ins. thick, the forms for these walls being raised from floor to floor by the crane.

The lumber from the old building was sold, as far as possible, and a great deal of it was used in the forms. Brick which could not be sold was crushed and used for ballast in the tracks around the building.



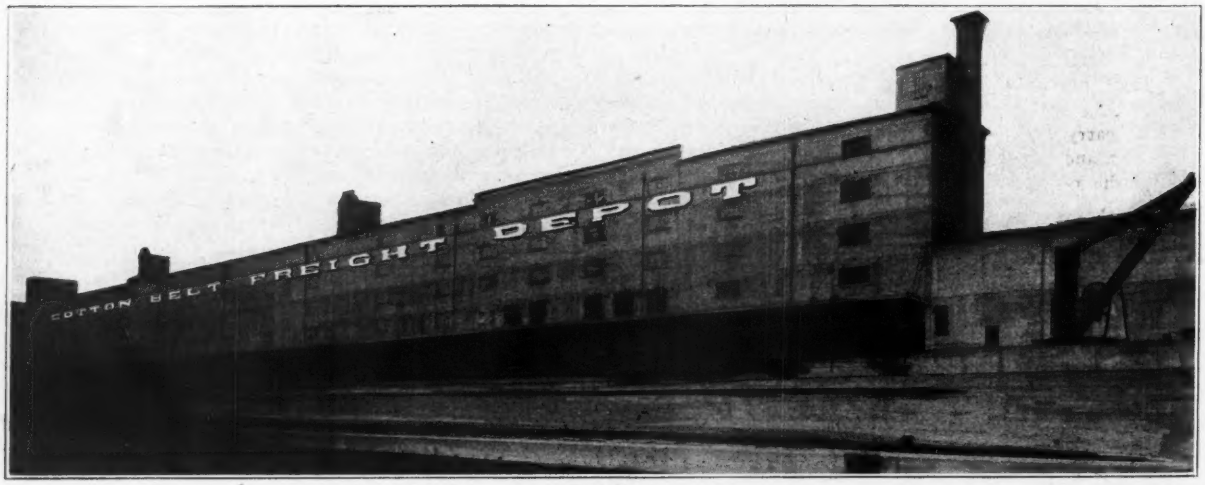
St. Louis Freight Station, Showing Concrete Tower Used in Construction.

The concrete mixture was as specified by the St. Louis building ordinance, and required a maximum of four parts coarse aggregate and two parts fine aggregate to one part cement, and in all cases fine aggregate to be 50 per cent. of coarse aggregate, fine aggregate to pass a No. 8 sieve; coarse material to pass through a 1-in. ring and be retained on a No. 8 sieve. The maximum allowable compression stress is 500 lbs., maximum shear 175 lbs., and maximum tension (steel) is 14,000 lbs.

The several retaining walls are similar in design, of plain gravity section. The cap at the top of a typical section is 2 ft. 3 ins. wide, and 12 ins. thick, projecting 3 ins. beyond the face of wall. The face batter is 1 in. per foot, and the back batter is 3 ins. per foot. A large yardage of retaining wall was necessitated by the slope to which the layout had to conform.

The connecting ladder track from Lewis to First street has a grade in excess of 1 per cent. (In the three sections of the diagram, dot and dash lines show the centers of corresponding tracks.) In general, yard tracks are on 12½ ft. centers.

The terminal was designed and built under the direction of Mr. C. D. Purdon, member A. S. C. E., chief engineer of the system. Mr. O. D. Schmidt, chief draftsman, bridge and building department, was architect for the building. Thompson & Scott were the general contractors. The steel frame was fabricated and erected by Christopher & Simpson. The plumbing and heating system was installed by



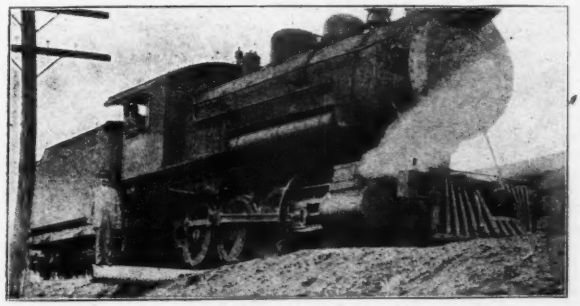
New Cotton Belt Station, St. L. S. W. Ry.

the Wm. Burke Plumbing Company, and the sprinkler system by the Globe Automatic Sprinkler Company. Mr. Ed Samen was superintendent for the contractors and Winters Haydock was resident engineer. We are indebted to C. D. Purden, chief engineer, and Winters Haydock, resident engineer of the St. Louis Southwestern Ry., for the information and illustrations given herein.

TRUTH IN ADVERTISING.

The information imparted by advertisements in the technical journals is in many cases of value to the engineer. By this we do not mean the cleverly written advertisements which gain access to the reading columns of the journals without charge because of the failure of the editor to "discover" their intent and purpose, but bonafide paid up advertisements. At times, however, some fellow who has had a life training in writing up "patent medicine ads," by some hook or crook gets into the field of commercial engineering and as a result the reader of the technical paper is treated to information (we should say fiction) that borders on the sensational, defying the laws of nature and good common sense.

Some time ago an advertisement appeared which to our mind is one of the most laughable things ever published in the technical press. A reproduction of the illustration in this advertisement appears herewith, and the statement was made that over 120 tons weight rested on the culvert which was installed immediately beneath the rails. It was stated that the engine weighed over 120 tons, the man 165 lbs., and the culvert was not deformed in the least by this load.



This culvert, installed immediately under the rails, must be endowed with supernatural or magnetic quality in order that the 120 tons (spread over at least 55 ft. of track) is concentrated, or pivoted, on the 12-in. culvert. This, as any schoolboy knows, is impossible. The fact is that the load spreads or radiates out over the fill and does not converge as would appear from the statements quoted.

It appears to us that about the only load carried by the culvert is the man at the end, weight 165 lbs. The culvert to be directly under the rails must be between two ties, in which case it is hard to see how the rail would deflect enough to make the culvert carry even one axle load. But we may be in error, however, and if it is true that one culvert placed immediately under the rail will support an engine 55 ft. long, then we have solved the tie problem. Simply insert a culvert every 55 ft. and dispense with ties.

The time is coming when advertisers will become aware of the fact that it pays to tell the truth, for such advertisements as the one cited drive away more business than they bring in.

RAILWAY CONSTRUCTION.

The Atchison, Topeka & Santa Fe, it is said, is considering expending $2,500,000 for construction this year.

The California, Shasta & Eastern has applied to the railway commission of California for authority to issue $797,000 worth of bonds and capital stock with a par value of $1,075,000 for the acquisition of the railway from Anderson, Cal., to Bella Vista, a distance of 16 miles, for its repair and reconstruction, and for the construction and equipment of an extension of 13 miles from Bella Vista, Cal., to Ingot, Cal.

The Clinton & Oklahoma Western, it is reported, is planning to construct an extension from Clinton east to Chickasha, Okla., about 75 miles, to connect with the Oklahoma Central.

The Enid, Ochiltree & Western will probably build 100 miles of line this year.

The Iowa Southern, of Des Moines, Ia., has been incorporated by William Garner, Richard Aishton, John Caldwell and Jonah Cleveland. They propose to build a 25-mile line from Albia, Ia., to coal mines at Centerville, Ia.

The Central of New England has filed application in Albany, N. Y., to issue $2,429,000 bonds for double tracking and new equipment.

The Minneapolis, St. Paul & Sault Ste. Marie, it is reported, will soon undertake the building of 725 miles of new road to cross the state of Montana and connect with the Canadian Pacific somewhere near the western boundary of Montana. This work will involve an expenditure of over $25,000,000.

The Missouri, Kansas & Texas now has surveys under way from Waco, Tex., southeast to the Beaumont & Great Northern at Weldon, also from this line at Livingston southeast towards Beaumont. The company recently bought the Beaumont & Great Northern, extending from Livingston northwest via Trinity to Weldon.

The Montezuma & Western will let contracts this spring to build from a connection with the Colorado & Southern at Silver Plume, Colo., west via Montezuma to the Colorado & Southern at Keystone. The plans call for building 39 miles of narrow gauge line. The total excavation will be about 690,000 cu. yds., of which 190,000 will be rock work.

The Montana, Oliver building, Pittsburgh, Pa., is asking for bids for the construction of 35 miles of rock ballast railway. Three tunnels and 20 bridges will be on the line.

The Oklahoma, New Mexico & Pacific has applied for a charter for the construction of its proposed line from Ardmore to Lawton, Okla. Capital, $2,500,000.

It is reported that surveys have been made to build a road from Sapulpa, Okla., west to Cushing, about 40 miles.

The Plateau Valley has been organized in Colorado to build from Yeckel Junction, Colo., which is on the Denver & Rio Grande, near Grand Junction, east to Collbran, about 40 miles. It is understood that construction work will be started soon.

The Port St. Joe Dock & Terminal, it is said, will build a terminal line 12 miles long and connect with the Apalachicola Northern Railroad at Port St. Joe, Fla.

The Riviera Beach has just been completed from Riviera Beach, a new resort on Baffen's Bay, 10 miles to Riviera, Tex., on the main line of the Frisco system in southern Nueces county. McKeen motor cars are to be used for passenger service.

The Rock Island, Stuttgart & Southern has been incorporated in Arkansas with $300,000, to build a line from Mesa, Ark., south to Stuttgart, 22 miles.

The Southern will let contracts soon for the construction of double track north from Monroe, Va., the southern terminus of the Washington division, to Amherst, 8 miles. Contracts will also be let for the construction of double track from Twenty-seventh street, Birmingham, Ala., to the east end of the North Birmingham yard.

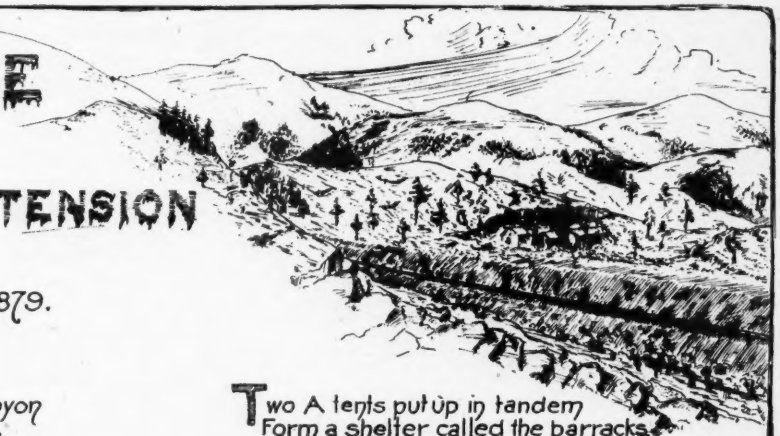
The Utah Construction Co., Ogden, Utah, has been awarded the contract for the construction of the Mountain Home cut-off, which as proposed will shorten the distance from Salt Lake City, to Boise, Idaho, 84 miles.

The Western Maryland, it is reported, will extend all passing tracks to 4,000 ft. clear length. The construction of 5 additional passing tracks of the same length has been authorized on the 80-mile section between Hagerstown, Md., and Cumberland. This involves the construction of about 7½ miles of track at a cost of from $250,000 to $300,000.

— NIGHT EDITION —

The Engineer's Distress.

CAMP LIFE ON THE LEADVILLE EXTENSION



Reminiscence of 1879.

By C. S. Annan.

On a shelf in Pine Creek Canyon
Stand the tents of the surveyors,
Three in number: the most sheltered
Is the "office": next the cooks and
Just beyond the awful barracks,
Taciturn, enwrapt and thoughtful,
Sits the "old man" at his table,
Stationary chest is open,
Tumbled blankets in a corner.
On the table is a candle,
Map of line and trial profile.
Transitman, with small protractor,
Leveler with sharpened pencil,
Sit near by in busy silence
Conning notes and grimly plotting.
Dimly glimmer the three candles,
In the stove the pinyon crackles,
And without the North wind whistles,
Thus, the night routine in office.

In the cooks tent things are different,
Rodmen, chainmen, axemen, teamsters
Come to while away the evening
At a little game of poker
Or to read or swap good stories,
Vivid tales of part experience.
At one end of the long table
(Which, old Bill has cleared for action
Moving back tin plates and dippers
Washed and ready stacked for breakfast)
Players sit and put up antes,
Bluff and raise, and lay down bobtails
Draw for flushes and full houses,
Open jack pots, bet the limit
Untill bedtime, then the losers
Cuss their luck and pay the banker.
There is Buffalo Bob and three fingered Jack,
Benny the hunchback and tenderfoot Mack,
Emmett, head chainman, Jack calls him Mike,
Bill from Missouri, County of Pike,
Panhandle George and Slippery Ike.

Two A tents put up in tandem
Form a shelter called the barracks.
Packed in pairs the party slumbers
On the hard and dusty surface
Of the bleak and barren hillside.
Bedsteads? Fir boughs? No not any.
First a wagon sheet is laid down,
And on this three pairs of blankets,
Then the sleepers, two more blankets
Form the covers, white with frosted
Breath by morning. Welcome morning.
Bob and Benny heavy breathers
Are a source of keen annoyance
With substantial imprecations.
Day break finds their couch surrounded,
Boots and boot-jacks and such missiles
Lay in heaps about the snorers.
Just at dawn the men are dressing,
Ice is broken for ablutions,
Bathed are bleeding lips, rough faces,
Hands made raw by dust corrosive
Ground to fineness alkaline
By the heavy ten mule freight teams
Passing on in line unceasing
To and from the camp at Leadville.

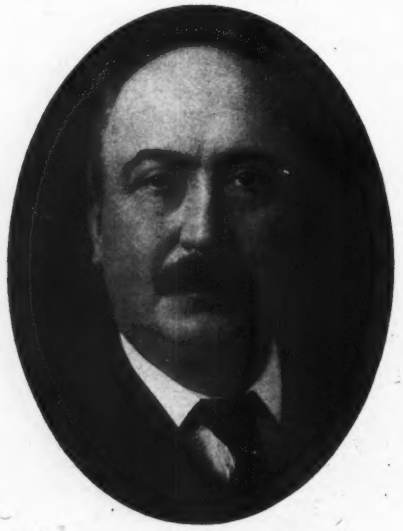
Soon the cook will sing out "Grub Pile"
Hurry up and all look pleasant.
Oat meal mush and fried potatoes,
Crisp sow-belly, hot strong coffee,
These will limber up the stiffness
Even though its ten below.

All aboard the Studebaker
Hitched to mules light buff in color
On the rattle, bumping, bouncing
Upward toward the breezy summit.
Instruments are held for safkey,
In the hands of George and Emmett
Trial lines, "preliminaries"
Will be run along the canyon,
Falling on the grade supported,
And with proper compensation,
Into gullies, over boulders,
Cut and fill adjusted nicely
With perhaps a loop or tunnel,
Reconciling length to gradient.
When the sun has climbed its highest
Leave the instruments on tripods
Drop the chain, the rod, the axes,
Build a fire and toast the bacon
Smear the light bread with dried apples
Stewed to dark consistence, salve like,
Luncheon bolted, fill the briarwoods
With "Lone Jack," perchance with "Durham."
Half an hour or so of respite
Freshens one for new endeavor.
In the afternoon the sun's rays
Melt the snow and make it sloppy
wet to knees, the weary "outfit"
Makes a break for camp at sundown.
But befor the day's works ended
One must in his turn play postman;
Mount the horse and through the pinyons
Growing thickly on the mesa
Make his way with difficulty
To the P.O. four miles distant.
Ah! the grandeur of the mountains
In the silent, early darkness
Of a solemn wintry night,
Clear and cold, serene and lifeless.
When the moon is slowly mounting
Oer the peaks that line the valley,
Peeping over the Sierra.
All its western slope in shadowy,
Indistinguishable gloom,
Comes Diana in her glory.
The opposing range gleams coldly.
Nave and blue above the timber
Clearly marked is each depression,
While below the glint on pinyons
Holds in thrall the awed beholder
Fixed in solitary rapture.
One day's work is like another,
Now in canyon then on mesa
Ever near the traveled highway
Passing freights and profane teamsters
Often serve to make commotion.
Carcases of mules distended
Lie at base of short steep rises
Where they fall in final effort
To advance the heavy wagons.
On the down freights wooden boxes
Oft protrude in way suggestive
"Wooden overcoat" says Emmett.
Air too light" adds Jack three fingered,
"Too much whiskey" Bobs opinion.
On the Arkansas headwaters
At the altitude nine thousand,
Air is thin and cold is piercing.
Alkali dopes air and water,
Rheumatism clings tenacious,
Still there must be compensation
In this life of strain and hardship
For the average Surveyor.

Personals

Operating Department

David L. Bush, who has been elected vice-president of the Chicago, Milwaukee & St. Paul Ry. Chicago, was born on July 31, 1855, at Sharon, Wis. He entered railway service in December, 1872, as night operator for the Western Union Ry., and was later to January, 1877, chief operator in the train despatcher's office of that road at Racine, Wis. He was subsequently until September, 1880, train despatcher; from May 1, 1877, to January 1, 1882, superintendent of that road and also of the Sabula, Ackley & Dakota, and from September, 1880, to July 1, 1887, also superintendent of the Racine & Southwestern division of the Chicago, Milwaukee & St. Paul Ry. On the latter date he was transferred to the



DAVID L. BUSH, Vice-President, C., M. & St. P. Ry.

James River division, as superintendent and from February 1, 1888, to February 1, 1890, was superintendent of the Southern Minnesota division. He then became superintendent of the Hastings & Dakota division, where he remained until August 15, 1894, when he was transferred to the River division as superintendent, with headquarters at St. Paul, Minn. April 1, 1898, he was promoted to assistant general superintendent, with office at Milwaukee, Wis., and May 1, 1903, was made general superintendent. He was appointed general manager, with headquarters at Chicago, October 1, 1909, and his election to the office of vice-president was effective on January 23.

W. H. Penfield, formerly assistant chief engineer, has been appointed assistant to vice-president D. L. Bush, Chicago, Milwaukee & St. Paul Ry., office at Chicago.

W. S. Townsend has been appointed general manager of the Albany Southern R. R. at Albany, N. Y., succeeding R. H. Smith.

A. W. Towsley, formerly superintendent on the Chicago & Northwestern, has been appointed vice-president and general manager of the Ann Arbor R. R. office at Toledo, O.

F. M. Falck, who was appointed superintendent of the Atlantic City R. R. at Camden, N. J., January 1, was born January 5, 1874, at Atlanta, Ga. He attended public school at Elmira, N. Y., and attended Cornell University. He entered railway work in 1898 with the Philadelphia & Reading Ry. as assistant supervisor at Shamokin, N. J; was appointed supervisor at the same location in 1901, and transferred to Trenton, N. J., in the same capacity in 1902. In 1903 he was appointed division engineer at Tamaqua and was transferred to Reading in 1905 in the same capacity. He was appointed assistant superintendent in March, 1910, at Reading, and was appointed superintendent at the same location, October, 1910, which position he held until his present appointment.

A. E. Warren, formerly general superintendent, was appointed assistant to the general manager of the Canadian Northern Ry. at Winnipeg, Man. A. Wilcox was appointed general superintendent, Central division, Winnipeg, Man., succeeding Mr. Warren. W. A. Brown, formerly superintendent, was appointed general superintendent of the Western division office at Edmonton, Alberta, succeeding A. Wilcox. B. T. Chappell, formerly trainmaster, was appointed superintendent at Saskatoon, Sask., succeeding J. G. Entwhistle, superintendent, transferred to Edmonton, Alberta, vice W. A. Brown, promoted. The above appointments took effect December 30, 1912.

A. D. MacTier, who was appointed general manager of the Canadian Pacific Ry., Western Lines, January 1, was born at Blairgowrie House, Scotland, December 27, 1867. He entered the service of the Canadian Pacific in the general baggage agent's office in 1887, and was successively employed in the offices of the general superintendent, the general superintendent of sleeping, dining and passenger cars, and in the stores and car service departments. In 1896 he was appointed general baggage agent, was appointed general fuel agent in 1899, and in June, 1907, he was made assistant to vice-president. The latter position he held until his appointment as general manager at Montreal, Que.

E. B. McClure, who was appointed superintendent of the Chicago & Northwestern Ry. at Sioux City, Ia., January 1, was born November 29, 1865, at Wyoming, Ia. In 1881 he entered the service of the Chicago & Northwestern as machinist's apprentice in the Clinton, Ia., shops, leaving this position to become a locomotive fireman in 1886. The following year he was transferred to the Northern Iowa division with headquarters at Lake City. He was promoted to locomotive engineer in 1889 and served in that capacity for twelve years. He was appointed road foreman of engines in 1901, at Sioux City, and in 1907 was appointed trainmaster of the Northern Iowa division at Eagle Grove, which position he held till his present appointment.

W. D. Danley was appointed superintendent of the Chicago, Peoria & St. Louis R. R., with offices at Springfield, Ill., effective January 13.

G. W. Rourke has been appointed superintendent of the Chicago, Rock Island & Pacific Ry. at Rock Island, Ill., effective January 8. He succeeds H. L. Reed, superintendent, who has been transferred to Eldon, Mo. A. B. Ramsdell, formerly superintendent at Eldon, has been transferred to Herington, Kan,, succeeding Mr. Rourke.

J. W. Kennedy, formerly superintendent, has been appointed assistant to the general manager of the Chicago, St. Paul, Minneapolis & Omaha Ry., office at St. Paul, Minn. F. E. Nicoles, formerly superintendent at St. James, has been transferred to Eau Claire, succeeding Mr. Kennedy. J. K. Welch, formerly superintendent at Omaha, Neb., succeeds Mr. Nicoles at St. James, Minn. E. C. Blundell, formerly assistant superintendent, has been appointed superintendent at Omaha, Neb., succeeding Mr. Welch.

L. J. Ferritor was appointed superintendent of Delaware, Lackawanna & Western R. R. at Scranton, Pa., effective January 1, succeeding F. M. Nowell.

C. S. Ruttle was appointed general superintendent of the Detroit, Bay City & Western R. R., office at Bay City, Mich., effective January 15. A. C. McDanel, formerly auditor and car accountant, has been appointed superintendent, office at Bay City, Mich.

H. E. Whittenberger, who was appointed general superintendent of the Grand Trunk Ry., Ontario Lines, at Toronto,

Ont., January 14, entered railway service with the Wabash R. R. in 1885, holding successively the positions of brakeman, freight conductor and passenger conductor until 1898, when he was appointed trainmaster of the Grand Trunk Ry. at Stratford and London. In 1902 he was appointed superintendent of the Denver & Rio Grande R. R., at Alamosa, later being transferred to Pueblo, Colo. He went with the Cincinnati, Hamilton & Dayton Ry. as superintendent at Indianapolis, Ind., in 1904, and accepted a similar position with the Kansas City Southern Ry. at Pittsburg, Kan., in 1906. In 1907 he was appointed superintendent of the Grand Trunk Ry. which position he held until his present promotion.

C. G. Bowker was appointed general superintendent of the Grand Trunk Ry., Eastern Lines, with office at Montreal, Que., effective January 14. He entered the employ of the Grand Trunk in 1900, as train dispatcher at London, Ont., and subsequently held the positions of train dispatcher at Durand, Mich., chief dispatcher at Stratford, trainmaster at Stratford, assistant superintendent at London, and superintendent of the Southern division at St. Thomas.

U. E. Gillen, formerly superintendent, has been appointed general superintendent of the Grand Trunk Ry., Western Lines, office at Montreal, Que. H. F. Coyle was appointed superintendent at Belleville, Ont.; J. J. Connolly was appointed superintendent at Montreal, Que., and R. W. Scott was appointed superintendent at Montreal, Que., all effective January 20. J. H. Gordon has been appointed superintendent at Hamilton, Ont. G. A. Stokes has been appointed superintendent at Toronto. W. S. Wilson, formerly trainmaster, has been appointed superintendent of transportation at Toronto, Ont. P. J. Lynch has been appointed superintendent at Allandale. W. R. Davidson has been appointed superintendent at London. C. Forrester has been appointed superintendent at Stratford, Ont.

W. E. Higgins has been appointed acting vice-president and general manager of the Lackawanna & Wyoming Valley R. R., at Scranton, Pa., succeeding C. F. Conn.

W. H. Coppage has been appointed superintendent of the Louisiana Ry. & Navigation Co., office at Shreveport, La., succeeding A. G. Abell, resigned.

Herman Hall, formerly division engineer, was appointed general superintendent of the Louisiana Western R. R. at New Orleans, La., effective January 1.

S. H. Charles, formerly trainmaster, has been appointed superintendent of the Missouri, Kansas & Texas Ry., at Oklahoma City, succeeding W. E. Brown.

T. Mancera has been appointed superintendent of the National Rys. of Mexico at Acambaro, Gto., Mex., succeeding V. E. Palacios.

L. M. Jones has been appointed assistant general manager of the Norfolk Southern R. R., office at Norfolk, Va. C. W. Akers was appointed superintendent January 1 at New Bern, N. C., succeeding Virgil Walker.

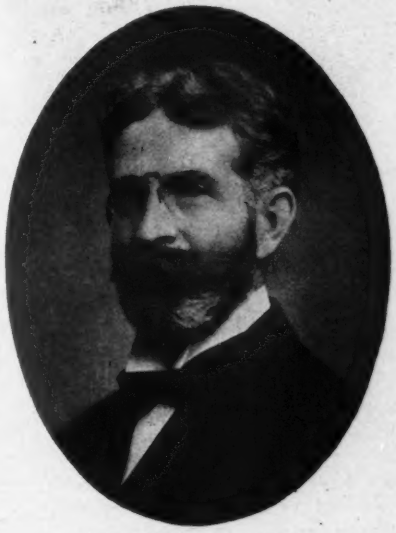
J. J. McCullough, who was appointed superintendent of the Northern Pacific Ry., January 1, Seattle, Wash., was born June 17, 1871, at De Soto, Ill. He attended public school and entered railway service in 1888 as brakeman on the Illinois Central R. R. and later in the year became brakeman on the Minneapolis & St. Louis Ry., at Minneapolis. He was promoted to conductor in 1890 and in 1894 accepted a position as yardmaster on the Great Northern Ry. at Superior, Wis. In 1896 he was made general yardmaster of the Lake terminals, and resigned in 1900 to accept the position of general yardmaster of the Erie R. R. at Susquehanna, Pa. Later in the same year he was transferred to the eastern terminals in the same capacity. He went with the Minneapolis, St. Paul & Sault Ste. Marie Ry. at Minneapolis in 1907 as yardmaster, leaving to accept the position of general yardmaster of the Northern Pacific Ry. at Billings, Mont. He was appointed yardmaster of the Rocky Mountain division, and three months later became senior trainmaster on the Montana division at Livingston, Vt. He was appointed inspector of terminals of the entire system with headquarters at St. Paul in 1910, which position he held until his recent appointment.

Effective January 6, A. C. Bradley was appointed superintendent of the San Bernardino division, Pacific Electric Ry., San Bernardino, Cal.

J. A. Gordon, who has been appointed general superintendent of the Pere Marquette, office at Detroit, Mich., entered railway service in 1884 as telegraph operator on the Cincinnati, Hamilton & Dayton Ry. He held successively the positions of yard clerk, station agent, clerk in the accounting department, chief clerk in superintendent's office, and was appointed trainmaster in 1893. He was appointed division superintendent in 1896, and general superintendent in 1904. During the reorganization of that railway, he accepted the position of superintendent of the Kansas City division of the Chicago, Great Western R. R. in 1910, and was transferred to the Chicago division in 1911, which position he held till his appointment with the Pere Marquette.

W. F. Eckert, who was appointed superintendent of the Philadelphia & Reading Ry. at Reading, Pa., January 1, entered railway service with this railway as a telegraph operator in 1881. He was appointed train dispatcher in 1886, assistant trainmaster September 17, 1900, and chief train dispatcher September 29, 1900, which position he held till his present appointment.

L. A. Boyd was appointed superintendent of the Raleigh, Charlotte & Southern Ry. January 1, office at Biscoe, N. C., succeeding Frank Page, resigned.



J. A. GORDON, Gen. Supt., Pere Marquette R. R.

C. G. Arthur has been appointed superintendent of the Southern Ry. at Charleston, S. C., succeeding W. C. Hudson, transferred to Columbia, S. C. Mr. Hudson succeeds H. A. Williams.

Effective January 1, C. W. Ketcham was appointed superintendent of the Southern Pacific Co. at Stockton, Cal.

J. W. Williams, formerly superintendent, has been appointed assistant general superintendent of the Southern Pacific R. R. of Mexico at Empalme Son., Mex. C. J. Anderson, formerly assistant superintendent, has been appointed superintendent at Mazatlan Sin., Mex., succeeding J. W. Williams.

A. R. Merrick, who was appointed general superintendent, of the Western Maryland R. R., January 1, Baltimore, Md., was born December 9, 1874, at Port Austin, Mich. He at-

tended grammar school at Bad Axe, Mich., and entered railroad service on June 1, 1891, as a passenger brakeman on the Saginaw, Tuscola and Huron R. R. (now one of the consolidated lines of the Pere Marquette). After one year as passenger brakeman, he became freight brakeman, remaining in that position four years, when he went with the Chicago & Grand Trunk R. R. (now G. T. R. R.) but returned to the S. T. & H. R. R. eighteen months later in 1899 as freight conductor. He was made passenger conductor in 1901, and trainmaster, Toledo division, P. M. R. R., in March, 1902; he was transferred to the Ludington division, and in July, 1902, to the Chicago division, and was made superintendent of the Saginaw district, comprising 1,045 miles March 1904, which position he held until December 1, 1911, when the Pere Marquette R. R. was redistricted, he remaining at Saginaw in charge of the Saginaw division, comprising the Toledo-Ludington and S. T. & H. divisions. The territory was again redistricted in May, 1912, Mr. Merrick this time having charge of the Saginaw-Ionia-S. T. & H. division,

H. W. McMASTER, Gen. Mgr., W. & L. E. R. R.

from which position he resigned December 29, 1912, to become general superintendent of the Western Maryland R. R.

H. W. McMaster, who was appointed general manager of the Wheeling & Lake Erie R. R. January 1, Cleveland, O., was born at Georgetown, Ont., September 29, 1860, and was educated in the public schools of Pontiac and Grand Ledge, Mich. He entered the service of the Lansing & Northern R. R. as telegraph operator in 1874, and accepted a similar position with the Grand Rapids & Indiana R. R. in 1878, and two years later was appointed train dispatcher. In 1882 he accepted the position of train dispatcher on the Peninsular division of the Chicago & Northwestern Ry., leaving to accept a position as chief train dispatcher on the Oregon Short Line R. R. in 1884. Later he was appointed trainmaster, resigning in 1889 to go with the Northern Pacific Ry. as chief dispatcher at Spokane, Wash. In 1893 he was promoted to trainmaster and left in 1900 to enter the service of the Wheeling & Lake Erie R. R. as superintendent at Massillon, O. In 1905 he was appointed general superintendent of the consolidated lines of the Wheeling & Lake Erie R. R., the Wabash-Pittsburgh Terminal Ry., and the West Side Belt R. R. at Pittsburgh, Pa. He was appointed receiver and general manager of the Wabash-Pittsburgh Terminal Ry. in 1908, which position he held till his present appointment took effect.

Engineering Department

R. B. Ball, who was appointed engineer Grand division, January 1, Atchison, Topeka & Santa Fe Coast Lines, was born in Missouri, December 17, 1878, moved to California in 1889, where he attended the public schools and graduated from Stanford University. He entered the service of the Atchison, Topeka & Santa Fe Ry. as chainman in 1901, but returned to college in 1902. After graduating in 1904 he reentered the service of the Santa Fe as transitman. From this time until January 1, 1910, he was employed in various locations on maintenance and construction till January 1, 1910, when he was appointed division engineer of the San Francisco terminals, which position he held until his present appointment. His office is now at Los Angeles, Cal.

R. S. Haynes was appointed division engineer of the Atchison, Topeka & Santa Fe Ry. at San Francisco, January 1 succeeding R. B. Ball, promoted.

M. A. Long, formerly architect, has been appointed assistant chief engineer of the Baltimore & Ohio R. R., office at Baltimore, Md.

W. M. Bond has been appointed assistant engineer, Baltimore & Ohio R. R., office at Baltimore, Md. E. T. Brown has been appointed division engineer maintenance of way at Grafton, W. Va.

C. R. Diemar has been appointed assistant engineer of the Baltimore & Ohio Southwestern R. R., Cincinnati, O.

R. C. Reamer has been appointed division engineer construction, Boston & Maine R. R., at Boston, Mass., succeeding A. H. Morrill.

H. A. Bertam has been appointed engineer maintenance of way of the Chesapeake & Ohio Ry. of Indiana at Covington, Ky., succeeding L. B. Allen.

B. R. Kulp has been appointed division engineer of the Chicago & Northwestern Ry. at Antigo, Wis., succeeding W. J. Jackson, who has been transferred to Madison, Wis. S. S. Long, formerly division engineer at Madison, has been transferred to Chicago.

H. E. Holt, formerly division engineer of the Puget Sound lines, has been appointed assistant chief engineer of the Chicago, Milwaukee & St. Paul Ry., office at Chicago, succeeding W. H. Penfield, promoted.

F. E. Watson has been appointed division engineer of the Chicago, Rock Island & Pacific Ry. at Trenton, Mo., succeeding R. Johnson.

Richard Birbeck, formerly assistant engineer, has been appointed chief engineer of the Cuba R. R. at Camaguey, Cuba. He succeeds A. L. Phillips.

F. R. Seargent has been appointed assistant engineer of the Cumberland R. R., office at Artemis, Ky.

A. G. Dorland was appointed assistant engineer of the Elgin, Joliet & Eastern Ry. at Gary, Ind., effective January 1.

C. S. Ogilvie has been appointed assistant engineer of the Grand Trunk Ry. at Bellville, Ont. F. L. C. Bond, formerly resident engineer, has been appointed division engineer at Montreal. G. Beckingham has been appointed superintendent of track; office at Montreal, Que. J. H. Johnston has been appointed superintendent of bridges and buildings, office at Montreal.

E. D. Reinking has been appointed master carpenter of the Great Northern Ry., at Whitefish, Mont.

T. H. Robertson has been appointed assistant engineer of the Illinois Central R. R. at Louisville, Ky., succeeding M. M. Backus.

W. W. Colpitts has resigned as chief engineer of the Kansas City, Mexico & Orient Ry.

Geo. B. Newbold was appointed assistant engineer of the Louisville & Nashville R. R. at Knoxville, Tenn., effective January 1, succeeding J. O. Ely, appointed roadmaster.

H. R. Carpenter, who was appointed engineer maintenance of way of the Missouri Pacific Ry. January 1, has been in

the service of this railway for the last seven years with the title of assistant engineer, as assistant to engineer of construction, and assistant to the chief engineer. Prior to that he was with the Union Pacific R. R. as locating engineer, engineer in charge Denver & Rio Grand R. R., chief engineer Colorado Springs & Cripple Creek District Ry., and engineer in private practice at Denver, Colo.

F. K. Bennett, assistant engineer, Missouri Pacific Ry., has been transferred from St. Louis to Kansas City, Mo.

H. H. Gibson has been appointed chief engineer of the New Orleans Southern & Grand Isle Ry., office at Algiers, La.

Alexander M. Lupfer has been appointed chief engineer of the Oregon Trunk Ry., at Portland, Ore., succeeding Ralph Budd, resigned to accept a position with the Northern Pacific Ry.

A. A. Wirth has been appointed supervising engineer of the Pennsylvania Lines West, Northwest System, office at Pittsburgh, Pa. A. Hawley has been appointed division engineer at New Castle, Pa., succeeding W. R. Hillary. E. F. McCrea has been appointed division engineer at Cleveland, O., succeeding H. E. Newcomet. E. B. Taylor, Jr., has been appointed division engineer at Pittsburgh, Pa. H. W. Brown has been appointed assistant engineer at Cleveland, O., succeeding A. C. Watson. E. G. Johnson has been appointed assistant engineer at Allegheny, Pa., succeeding R. R. Metheany, Jr. The above appointments took effect January 1.

E. F. McCrea, appointed division engineer of the Pennsylvania Lines West, at Cleveland, O., was born Nov. 7, 1880, at Logansport, Ind., and was educated in the Logansport schools, graduating from high school in 1898. He entered railway service as assistant on engineering corps, Grand Rapids & Indiana Ry., in 1899, and was transferred to the C. & P. division of the Pennsylvania Lines in 1901. He was appointed assistant engineer on the Richmond division in 1904, and transferred in the same capacity to the C. & P. division in 1905, and to the Pittsburgh division in 1908. In 1911 he was appointed division engineer of the C. & M. V. Ry., and was transferred in the same capacity to the Toledo division February 1, 1912, and to the Cincinnati division November 1, 1912, which position he held till his present appointment.

W. R. Hillary has been appointed supervising engineer of the Pennsylvania Lines West, Central system, office at Toledo, O. R. R. Metheany, Jr., has been appointed division engineer at Cambridge, O., succeeding G. W. Hodgin. R. C. Miller has been appointed division engineer at Toledo, O., succeeding E. F. McCrea. M. P. Tucker, Jr., division engineer, has been transferred to Akron, O., succeeding R. C. Harris. A. C. Watson has been appointed division engineer at Zanesville, O., succeeding M. P. Tucker. J. A. Rothrock has been appointed assistant engineer at Zanesville, O., succeeding E. H. Kersting. The above appointments took effect January 1.

R. R. Metheany, Jr., appointed division engineer of the Pennsylvania Lines West at Cambridge, O., entered railway service as rodman on the Grand Rapids & Indiana Ry., in 1900. He was assistant on engineering corps, Cleveland and Pittsburgh division of the Pennsylvania Lines from September 1, 1901, to December 12, 1904. In 1904 he was appointed assistant engineer on the Marietta division and was transferred in the same capacity to the Louisville division in 1906, to the C. & M. V. Ry. in 1901, and to the Eastern division in 1908, which position he held till his present appointment.

A. C. Watson, appointed division engineer of the Pennsylvania Lines West at Zanesville, O., was born July 11, 1881, at Canton, O. He was educated at Washington & Jefferson College and entered railway service as assistant on engineering corps, Vandalia R. R. in 1904. He was transferred in the same capacity to the chief engineer's corps, February 15, 1905, and was appointed assistant engineer on the Indiana Terminal division of the P. C. C. & St. L. Ry. July 22, 1905. In 1910 he was transferred, in the same capacity to the Richmond division, in 1911 to the Western division, and in 1912 he was transferred to the C. & P. division as assistant engineer, which position he held till his present appointment.

R. C. Harris has been appointed supervising engineer of the Pennsylvania Lines West, Southwest division, office at Columbus, O. G. R. Barry has been appointed division engineer at Logansport, Ind., succeeding E. B. Taylor, Jr. S. W. Hodgin has been appointed division engineer at Richmond, Ind., succeeding F. N. Crowell, transferred to Cincinnati, O., succeeding E. F. Coes. T. L. Doyle has been appointed assistant engineer at Logansport, Ind., succeeding H. W. Brown. E. H. Kersting has been appointed assistant engineer at Cincinnati, O., succeeding J. K. Sherman, transferred to Pittsburgh, Pa., vice W. A. Hawley. C. C. Ohliger has been appointed assistant engineer at Indianapolis, Ind., succeeding E. G. Johnston. W. I. Phelps has been appointed assistant engineer at Columbus, O., succeeding R. C. Miller. The above appointments took effect January 1.

G. R. Barry, appointed division engineer of the Pennsylvania Lines West at Logansport, Ind., was born July 12, 1878, at Hillsboro, Ill. He was educated at the University of Illinois and started work as a track apprentice on the Illinois Central R. R. in 1899. He entered the service of the Pennsylvania Lines West in 1900 as assistant on engineering corps, and was later assistant engineer on various divisions until February 1, 1912, on which date he was appointed division engineer of the Zanesville division. November 1, 1912, he was transferred to the Toledo division, and January 1, 1913, he was transferred to the Logansport division as division engineer.

Walter Sebastian has been appointed assistant engineer of the Philadelphia & Reading Ry. at Philadelphia, Pa.

W. D. Faucette, who was appointed chief engineer of the Seaboard Air Line R. R., January 1, was born at Halifax, N. C., in 1881. He graduated from the State College of North Carolina, later taking the degree of civil engineer. He was connected with the American Society of Civil Engineers for nearly 10 years and entered the service of the Seaboard Air Line Ry. in 1901 as inspecting engineer on terminals, river and harbor work. He was later made assistant engineer in the office at Savannah, Ga. In 1904 he was appointed assistant engineer in charge of territory in South Carolina, Georgia, Florida and Alabama, and in 1906 was appointed assistant engineer in the chief engineer's office at Portsmouth, Va. He was appointed chief clerk to the president in 1910, at New York City, under President Meldrum, and was transferred to Norfolk, Va., with W. J. Harahan, president, in 1912, holding the position of chief clerk to the president until his present appointment.

A. S. Cook, who was recently appointed assistant chief engineer of the Transcontinental Ry., Ottawa, Ont., was born at Penobsquis, N. B., November 20, 1873. He entered the engineering profession in 1899 as engineer in charge of construction of various parts of the Dominion Iron & Steel Co.'s plant, at Sydney, C. B., and was with this company until 1901, and again for several months in 1902. During 1901 he was located on the Nova Scotia Eastern Ry. surveys, and on special survey work for the city of Sydney, and in 1901-1902 was on Cape Breton Ry. construction surveys, and in charge of office. He was in charge of location and construction of the Electric City Street Ry. for Cape Breton Electric Co., at North Sydney, Sydney Mines, Glace Bay, in 1902-3, and in the latter year became division engineer for the Chateauguay & Northern Ry. in Quebec. In 1904-1907 he was resident engineer for the Dominion Power & Transmission Co., of Hamilton, Ont., in develop-

ment and extension of an hydraulic power plant at St. Catharines. During the winter seasons of 1906 and 1907 he was in charge of surveys, plans, etc., for the Buffalo, Niagara & Toronto Ry. Co.'s proposed electric railway from Niagara-on-the-Lake and St. Catharines to Fort Erie. He went with the Clifton, Sand, Gravel & Construction Co. in 1901 to design and construct the Conlagas smelter at Thorold. September, 1908, to January, 1911, he was with the Lincoln Paper Mills Co., in charge of design and construction of an 1,800-h. p. hydraulic power plant and buildings for paper mills, at Merritton, Ont. January, 1911, to November, 1911, he was resident engineer for the Dominion Power & Transmission Co., in charge of further extensions at St. Catharines, Ont. He was appointed inspecting engineer for the Transcontinental Ry., with headquarters at Ottawa, on December 1, 1911, which position he held until his appointment as assistant chief engineer.

Maintenance of Way

R. W. Gabriel has been appointed assistant supervisor of the Baltimore & Ohio Southwestern R. R. at North Vernon, Ind. D. Cassin has also been appointed supervisor at North Vernon, Ind.

C. H. Hile, who was appointed chief of bureau of maintenance January 1, Boston Elevated Ry., graduated from the mechanical engineering course, Pennsylvania state college, in 1892. He took a post graduate course in street railways at the University of Wisconsin. In 1893 he entered the service of the Philadelphia Traction Co. as engineer, in connection with the electrification of the horse-car system, and in 1894 entered the service of the West End Street Railway Co. as superintendent in charge of the installation of the underground feeder and return. In 1905 he was appointed assistant vice-president, Boston Elevated Ry., which position he held till January 1, 1913. On this date the Bureau of Operation was split up into the Bureau of Transportation and the Bureau of Maintenance, Mr. Hile being appointed chief of the latter.

G. M. Elliott has been appointed assistant roadmaster of the Canadian Northern Ontario at Toronto, Ont.

J. W. Strong has been appointed supervisor of the Chesapeake & Ohio Ry. at Quinnimont, W. Va., succeeding C. A. Stanley, who has been transferred to Logan, W. Va.

J. A. Trainor, roadmaster, Chicago, Rock Island & Pacific Ry., has been transferred from Booneville to Brinkley, Ark. W. R. Coln, formerly roadmaster at El Dorado, succeeds Mr. Trainor at Booneville, Ark.

F. E. Connors has been appointed assistant roadmaster of the Great Northern Ry. at Butte, Mont., succeeding E. H. Brock. J. Swanson has been appointed assistant roadmaster at Essex, Mont., succeeding C. G. Bannon.

M. M. Backus, formerly assistant engineer, has been appointed supervisor of the Illinois Central R. R. at Carbondale, Ill. Thomas Quigley has been appointed roadmaster at Dubuque, Ia., succeeding C. W. Pifer. C. W. Lentz has been appointed supervisor of bridges and buildings at Dubuque, Ia., succeeding P. McKenna. E. A. Snavely has been appointed supervisor at Sardis, Miss., succeeding L. Zeigler.

Thomas McKenna was appointed roadmaster of the Lake Superior & Ishpeming Ry. at Marquette, Mich., effective January 1. He has been connected with this company for the past fifteen years as section and extra gang foreman, and acting roadmaster.

J. E. Bone, roadmaster of the Missouri Pacific Ry., has been transferred from St. Louis, Mo., to Malvern, Ark. H. Roberts, roadmaster, has been transferred from Le Roy to Coffeyville, Kan. A. Boydston was appointed roadmaster at Beebe, Ark., January 1. He had been located at this place for two years as general foreman. A. C. Hinckley has been appointed roadmaster at Monroe, Ark., succeeding J. W. Welsh.

B. P. Willis has been appointed roadmaster of the Norfolk & Western Ry. at Jaeger, W. Va.

H. Garrigues has been appointed supervisor of the West Jersey & Seashore R. R. at Millville, N. J., succeeding R. H. Pinkham.

Signal Officials

S. U. Rhymer, formerly signal supervisor, has been appointed general signal supervisor of the Chicago & Alton Ry., office at Bloomington, Ill. R. D. Boynton and P. C. Peters have been appointed signal supervisors, headquarters at Bloomington, Ill.

J. J. Corcoran has been appointed signal inspector of the New York Central & Hudson River R. R. at Albany, N. Y., succeeding A. E. Ditsch.

The Canadian Pacific, it is reported, will replace ten wooden bridges along the line of the Dominion Atlantic Ry. with modern steel structures.

The Chicago & Alton has placed orders with the Wisconsin Bridge Co., for 1,100 tons of steel for a bridge over the Illinois river.

The Chicago, Rock Island & Pacific and the city of Memphis, Tenn., have completed negotiations with reference to the railway's terminals at that pont. The improvements planned, including a bridge, are expected to cost about $5,000,000. A subsidiary corporation has been formed for accomplishing the work, the Arkansas & Memphis Railroad Bridge & Terminal Co., and work of construction is to be begun next July.

The Duluth, Missabe & Northern will let a contract shortly for the construction of a new ore dock at the head of the lakes, to be built of concrete and steel, and to cost approximately $2,750,000. The dock will have 384 pockets of a storage capacity of 300 tons each.

The Grand Trunk has filed plans with the City Council of Toronto, Ont., Can. for new tracks and a round-house between Spadina avenue and John street. The new roundhouse will have stalls for the accommodation of 26 locomotives and there will be a machine shop in conjunction with it.

The Michigan Central, it is reported, will build a 250-ft. extension to its shops at Jackson, Mich. A tank shop and a new blacksmith shop are also under consideration.

The Missouri, Oklahoma & Gulf will increase its facilities for repairing equipment by building at Muskogee, Okla., machine shops, power plant, carpenter shop, freight car repair shop and some temporary buildings.

The Nashville, Chattanooga & St. Louis, it is reported, will erect a new passenger station at Knoxville, Tenn.

The Pennsylvania placed an order with the American Bridge Co. for 6,600 tons of steel, for a new bridge at Sheridan, Pa.

The St. Louis Southwestern has just completed a new freight house at St. Louis, Mo., 750 feet long, 30 feet wide and five stories high, together with a yard of ten tracks, a transfer platform 500 feet long and a team track yard of five tracks.

The Southern Pacific, it is reported, has authorized the expenditure of $20,000 for improving its roundhouse and terminals at Shreveport, La.

The Texas & Pacific, it is reported, has ordered 1,050 tons of bridge steel from the Phoenix Bridge Co., for a structure at Melville, La.

The Alabama Great Southern, it is reported, will build a two-story brick passenger station at Bessemer, Ala., at an estimated cost of $25,000.

The Boston & Albany, it is said, is planning to erect a two-story station in Pittsfield, Mass., at an estimated cost of $450,000.

CONCRETE DEPARTMENT

Oil-Mixed Concrete

THE results of a long series of tests on the physical properties of oil-mixed concrete carried on by the Office of Public Roads, a summary of which is published in this issue, are of interest and value to the engineer as opening up a new method of attacking waterproofing problems.

The only drawbacks as disclosed by the tests are the decrease in compressive strength of oil-mixed mortar and concrete, and the decrease in bond or grip on reinforcing bars. The compressive strength of oil-mixed concrete is about 75 per cent of that of plain concrete at 28 days. This is not a serious objection since, as a general proposition where concrete requires, or is used in waterproofing, it very seldom is required to possess its full crushing strength, the thickness of the concrete being determined by features other than its crushing strength.

The fact that the bond of oil concrete on plain steel bars is decreased is to be expected. This, however, is not detrimental, for at the present time very few plain bars are being used by railroads in reinforced concrete construction. The question of doubtful bond values of plain bars under oft repeated loads, such as occur in railway structures, have led to the almost exclusive use of deformed or twisted bars in railway structures of reinforced concrete, very few engineers being satisfied to trust to luck by using plain bars.

The fact that oil-mixed mortar is effective as a waterproofing agent under low pressures when plastered on either side of porous concrete is of much importance. Of such a mixture can be applied to old walls and can be kept from cracking, many puzzling problems in waterproofing can be solved by its application.

ADAPTABILITY OF CONCRETE TO TRACK ELEVATION WORK.

Alfred W. Hoffman.

Grade separation in the larger cities was necessitated by their rapid growth, and has become one of the most important and most interesting problems of modern railroad engineering, because of the change in the types of structures due to the application of concrete; and also because of the difficult character of the work. To reconcile, in a manner satisfactory to all, the diverging interests of the city, the railway, and various other public utility corporations, is an engineering problem calling for the greatest skill and delicacy. As grade separation is not a dividend paying investment, it is required not only to satisfy the reasonable demands of all interested parties, but also to do so at a minimum cost to the railway.

In every case it is necessary to make exhaustive studies of the local conditions and all the problems involved in order to produce structures which are cheap in first cost, reasonably permanent, and which require little or no maintenance; and in addition to these practical questions, due consideration should always be given to the appearance of the structures which should be simple and without elaborate ornamentation, yet should show artistic outlines and harmonize with the surroundings.

The difficulty is, then, to find a material which will satisfy all or most of these practical and artistic requirements. After the successful application, on a large scale, of plain and reinforced concrete to railroad grade separation structures, it can be justly claimed that, of all structural materials concrete comes nearest to meeting even the most rigid requirements. A glance at the latest types of grade separation structures is sufficient to prove that the application of concrete has brought about great improvements, both in appearance and in service, over the older types. With the ever-growing use of concrete for this class of work, the possibilities for future development have likewise increased. Comprehensive research work has put concrete engineering on a firm and safe basis, and it is to be hoped that railway structures, as well as all other types of concrete structures, will be greatly benefited by the results of this scientific work, and by the favorable experience with this material. The knowledge of the principles of concrete engineering, and experience gained in practical application to railway work having rapidly increased in recent years, we are justified in drawing conclusions regarding the adaptability of concrete to railway grade separation work and also to look forward to a wider field of application.

Track elevation work presents, from the engineer's point of view, more interesting and more difficult problems than track depression. Structures for track depression are designed for lighter loads, shorter spans, and can, therefore, be built cheaply, in a manner pleasing to the eye. Concrete is quite commonly used for track depression as well as for track elevation work. In comparing the relative merits of depression or elevation, many points besides the structures must be taken into account, such as the cost of earthwork, the grades and lengths of street approaches, the damages to adjoining property, etc. Generally speaking, the earthwork for track depression is more expensive than for elevation, while the cost of the structures is lower for depression than for elevation.

The four factors which determine the amount of raise of the railroad grade are:

1. The allowable maximum grade on the railroad.
2. The clear headroom required over the crown of the street.
3. The amount of depression of the street grade at the intersection.
4. The depth of the floor construction of the bridges.

The last depends largely on the material to be used in the construction of the bridge superstructure. To reduce the depth of the superstructure of each bridge even a small amount, without increasing the cost of the bridges, may result in a considerable reduction of the cost per lineal foot of track elevation. For a ballasted deck which is usually required over city streets, the usually shallow floor is one of structural steel, encased in concrete, or of reinforced concrete throughout. The former construction is too expensive to be taken into consideration, except in special cases. The latter is the more preferable type of floor construction, and is now so generally used as to be almost a standard with many railways.

After the raised grade line has been determined, it becomes the basis of the design of the structures for which both plain and reinforced concrete can be used to advantage, and which may be classified as street subways, alley subways, retaining walls and other structures.

Street subways can be built of concrete throughout, or of

structural steel in connection with concrete. The most common type of concrete bridges for track elevation work is the reinforced concrete slab, on reinforced concrete piers and abutments. The concrete slabs being heavier than a steel floor with a wooden deck, they are more efficient in absorbing the vibrations and shocks resulting from trains operating over the bridge. Another advantage of the concrete slab over a steel floor is the absence of noise. It is sometimes argued that the impact of the trains tends to destroy the bond between the concrete and the steel. It is certain that the impact is partially absorbed by a heavy concrete structure, and its effect is not so destructive as the effect of impact on a steel structure where the rivets get loose in a comparatively short time. There is no way to prevent the rivets from losing their grip, while the reinforced concrete structure can be effectually safeguarded against the destruction of the bond by proper design and the use of reinforcing bars insuring a mechanical bond.

Reinforced concrete slabs for track elevation bridges should be carefully designed for all possible stresses, and should be placed so as to insure sufficient and uniform bearing on metal or on concrete. These slabs are, for the usual span lengths, more economical than steel construction. Wherever, for any reason, a steel floor is used, concrete is often used to encase the steel, or small concrete slabs are placed on top of the steel stringers or floor beams to support the ballasted deck, to absorb the impact, and to eliminate the noise. For long spans and for skew bridges, steel through girders are mostly used, because they are cheaper than concrete through girders, the weight of which increases rapidly with the span. There are, however, great possibilities in the development of concrete through girders with openings in the webs, or more properly speaking, of trusses with rigidly connected vertical members and without diagonals. Such trusses, of the Vierendeel type are not excessively heavy, even for long spans, and are supposed to be more economical than steel girders except for very long spans.

Wherever headroom over the street is ample and the character of the soil favorable, the concrete arch is a very economical structure, especially for long spans.

Recently the reinforced concrete T-beam slab design has been used more frequently, and apparently with good success. The T-beam slab offers the advantage of carrying the same live load as the solid slab on a much lighter structure, thereby reducing the permanent load on the foundations, and facilitating the handling of the slabs which are sometimes erected later instead of being built in place. The economy in handling the slab, and the saving in the cost of the foundations should always be credited to the cost of the T-beam slab. In some cases the reduction in the dead load moment of a T-beam slab is sufficient to reduce the minimum depth required for a solid slab. It is evident that the saving in the cost of the earthwork due to the reduced depth of the floor construction, should be charged against the solid slab. It is hoped that the experience gained with recently built large T-beam slabs for track elevation work will be published in the near future, with a view to throw more light on the relative economy of these structures.

An exceedingly important item in track elevation bridge work is the waterproofing of the superstructure. Various methods of making the concrete impervious by mixing with the concrete patented products are in use, or the concrete surface is covered with a waterproofing compound. Neither of these two methods has so far given complete satisfaction. The best plan seems to be to put a smooth finish of hard and dense concrete on the top surface of the slab. The surface should slope to gutter and drain pipes, which should be kept open to carry the water off as rapidly as possible. This arrangement requires practically no maintenance.

All reinforcing steel in track elevation structures should be well protected from electric currents to prevent destruction by electrolysis.

Piers supporting the superstructure are either built entirely of concrete or the concrete is used merely to protect the structural steel from injury by street cars or other vehicles, and to prevent corrosion. Reinforced concrete is more frequently used than plain concrete. For reasons of better appearance and in order to get more light under the bridge, piers are, in most cases, designed as a series of arches or beams supported by posts. Care should be taken to avoid excessive bearing of the superstructure on the edge of the top of the pier. The effect of excessive bearing are unsightly cracks and the spawling off of the concrete, whereby the effective bearing area is reduced, and the relative bearing increased. This important detail has not been treated right in many track elevation bridges of this type, and the result is that cracks have developed as described before. It is recommended that the top of the pier be beveled a few inches back from the edge to protect the edge. The top surface should also be reinforced as a further protection, and in order to distribute the load more uniformly over the entire area of the top of the pier.

The appearance can be greatly improved, at little or no additional cost, by projecting column bases and capitals, and by the design of well proportioned arches.

The foundation of structural steel piers must always be carried above the ground. Size and shape of the foundation depends on the nature of the soil and other local conditions. Care must be taken to avoid interference with sewers, water mains, gas mains and other ducts, as well as to avoid damage to the foundations of adjacent buildings. The same precautions should be taken in the design of the foundations for the abutments.

The types of concrete abutments are manifold, and no description can be attempted here, for lack of space. There are, however, some features to be considered, which are essential for city bridges, while they can, to a certain extent, be neglected in the design of abutments for bridges in the open country. The location of the abutments of track elevation bridges is, in most cases, absolutely fixed by the street and property lines. For a bridge in the open country the abutments can be located where they are most economical, while for a city bridge, economy cannot be considered in locating the abutment. It is, therefore, necessary to consider the question of economy in the design and construction of the abutments even more thoroughly.

All abutment types can be roughly classified as (1) those which resist the lateral earth pressure tending to overturn the abutment, and (2) those in which the earth pressure is eliminated or neutralized. The latter class (trestle or arch abutments), is, especially for considerable heights, more economical than the former, yet it cannot be used in city work except in few special cases. Most track elevation bridge abutments are of the earth pressure resisting type, i. e., retaining walls with provision for bridge seats supporting the superstructure. Gravity retaining walls, relying for their stability on the weight of the concrete itself, occur as frequently as reinforced concrete retaining walls relying for their stability mainly on the weight of the prism of earth carried on the heel. The two most common types of reinforced concrete retaining walls are the L-shaped, or contilever, wall, and the counterfort retaining wall. Track elevation bridge abutments have, in most cases, straight front walls and wing walls, along the right of way lines where the right of way is narrow. In plain concrete gravity abutments, the corners where the front wall and the wing walls join should be heavily reinforced to avoid unsightly cracks along these corners, due to the tendency of the front wall to overturn being resisted by the wing wall. Such cracks are to be found in some gravity abutments with wing walls where this precaution was not taken.

Which of the reinforced retaining wall abutment types is the most economical depends on the height and other local conditions. For relatively small heights the L-shaped wall of the highly reinforced type, or of the semi-gravity type is more economical than the counterfort abutment. For greater heights, however, the counterfort type is generally more economical than any other type.

The bridge seat of the abutment should be carefully detailed in the same manner as the top of the piers.

Retaining walls, besides being used for the abutments, occur very frequently along the right of way lines. Wherever the right of way is too narrow to allow the construction of an embankment for the required number of tracks, with the natural slope of the material, there arises a question as to whether the acquisition of additional right of way or the construction of retaining walls to hold the embankment is cheaper. No general rules are possible for this and similar problems.

The proportion of the cost of retaining walls per lineal foot to the total cost per lineal foot of track elevation, is naturally very high for a narrow right of way, and lower for a wider right of way. If, in addition to the right of way being narrow, the distance between street and alley crossings requiring overhead bridges is only short, then the construction of a continuous viaduct carrying the tracks may be more economical than the construction of an embankment held by retaining wall and interrupted frequently by a bridge. This question must be answered in each case by a thorough study of the local conditions. In some cases the location may be favorable to renting the space underneath the viaduct for storage or similar purposes, for freight offices, etc. There are still great possibilities along these lines, and we believe that, in some cases, more careful study would reveal chances to reduce the sum to be invested in track elevation, or to secure a small return on the investment. Where the value of real estate is very high, we can imagine that the space above the tracks might be economically utilized for office space. Such cases will, however, always be exceptional

Alley subways are not materially different from the street subways, except that the spans are shorter, and less attention is paid to the appearance of the structures.

Outside of the structures mentioned before, there occur various other types of structures, such as trestles supporting sidetracks, etc. For most of these special structures concrete can be used to advantage.

Wonderful as the progress of concrete applied to track elevation work has been in recent years, there is good reason to believe that the possibilities in this field are not yet exhausted. It should, however, be kept in mind that lasting success in this important branch of engineering is only possible if based on careful design, good workmanship and expert supervision of the work. These requirements are essential to concrete work everywhere. It should, however, be emphasized that they are of greater importance in railway work than anywhere else.

OIL-MIXED CONCRETE.

Bulletin No. 46, issued Aug. 8, 1912, by the Office of Public Roads, Mr. Logan Waller Page, Director, contains very interesting and specific information as to use of oil-mixed concrete for waterproofing purposes.

The oils which have been found to give the best results in laboratory and service tests of oil-mixed concrete, are petroleum residuum oils, conforming to the following specifications:

(1) The oil shall have a specific gravity at a temperature of 25° C. of not less than 0.930 nor greater than 0.940.

(2) It shall be soluble in carbon disulphide at air temperature to at least 99.9 per cent.

(3) The oil shall contain not less than 1.5 nor more than 2.5 per cent of bitumen insoluble in 86° B. paraffin naphtha.

(4) The residual coke yielded shall be not less than 2.5 nor more than 4 per cent.

(5) When 240 cu. cm. of the material are heated in an Engler viscosimeter to 50° C. and maintained at that temperature for at least 3 min., the first 100 cu. cm. which flow out shall show a viscosity of not less than 40 nor more than 45.

(6) When 20 grams of the material is heated for 5 hours in a cylindrical tin dish 2½ inches in diameter by 1 inch in height, at a constant temperature of 163° C., the loss in weight shall not exceed 2 per cent.

Brief specifications for material to be used are as follows:

Cement.—Portland cement should be used for all oil-mixed concrete on account of its more uniform quality, and greater strength which permits of the use of a larger percentage of properly proportioned aggregate. On all important work cement should be carefully sampled and tested by a properly equipped testing laboratory.

Sand.—The character of sand used in concrete has a marked effect on the strength of the concrete. Sand should be clean and coarse, free from clay or silt, since both these materials tend to weaken a rich concrete if present in large quantities. The sand grains should be graded in size from 1/32 up to ⅛ or ¼ inch in diameter, since a stronger mortar is is attained than if fine ungraded sand is used.

Stone.—Best rocks for concrete are traps and granites, and some varieties of sandstone and limestone. Clean gravel is excellent material. Bank gravel should not be used unless screened and reproportioned. Stone should be graded in size from ¼ inch up to 1½ inches, with a maximum of 1 inch preferable for reinforced work.

Water.—Water used in mixing should be clean and free from all strong acids, alkalies and vegetable matter.

Mixing.—About 5 per cent of oil based on weight of cement in mixture has been found to be sufficient for most purposes where damp-proofing is required. This is equivalent to about 2½ quarts of oil to each sack of cement. Sand and cement should be mixed dry, then water added and the mixing continued until the mortar is of a mushy consistency. The proper amount of oil should then be added and the mixture turned until the oil is thoroughly incorporated with it. Stone and gravel previously moistured should be combined with the oil-mixed mortar and the whole mass turned until the mixture is uniform.

When a machine mixer is used the cement, sand and water should be mixed first, then add alternate batches of oil and stone until the proper amount of oil is added; then place the remainder of stone in the mixer.

Bond Tests.—To determine the adhesion of oil-mixed concrete to steel reinforcement, bond tests were made on specimens of 1:2:4 concrete with varying percentages of oil incorporated in them. Rods 12 inches long were embedded in center of cylinders 8 inches in diameter and 8 inches long. The test consisted of pushing the rods through the concrete, and the point of failure was taken at the drop of the scale beam.

Plain and deformed bars were used. All specimens were tested at 28 days. The bond strength is decreased directly in proportion to the amount of oil used. The bond of plain bars is so seriously decreased by an oil mixture that it is inadvisable to use them in oil concrete, the decrease being about 63 per cent for 5 per cent of oil in mixture. The bond of deformed bars is decreased by the oil mixture but by no means so seriously, the decrease being only about 2 per cent for 5 per cent of oil in concrete.

It is believed that carefully prepared oil-mixed concrete, if used in structures requiring damp-proofing will prevent leakage and the extra expense will be slight. The efflorescence due to the leaching out and subsequent carbonization of lime on the surface of a concrete wall can be prevented by the incorporation of oil capable of excluding all moisture. The laboratory and service tests have demonstrated the damp-proofing properties of oil-mixed concretes and establish this material as one of great merit for certain types of concrete construction.

Conclusions.

The conclusions drawn from the investigation of the physical properties of oil-mixed concretes as given below, show very clearly the advantages and disadvantages thereof.

(1) The tensile strength of 1:3 oil-mixed is very little different from that of plain mortar, and at 28 days and 6 months shows a substantial gain in strength over that at 7 days.

(2) The times of initial and final set are delayed by the addition of oil; 5 per cent of oil increases the time of initial set by 50 per cent and the time of final set by 47 per cent.

(3) The crushing strength of mortar and concrete is decreased by the addition of oil to the mix. Concrete with 10 per cent of oil has 75 per cent of the strength of plain concrete at 28 days. At the age of 1 year the crushing strength of 1:3 mortar suffers but little with the addition of oil in amounts up to 10 per cent.

(4) The toughness or resistance to impact is but slightly affected by the addition of oil in amounts up to about 10 per cent.

(5) The stiffness of oil-mixed concrete appears to be but little different from that of plain concrete.

(6) Results of tests for permanent deformation indicate that no definite law is followed by oil-mixed concrete.

(7) Oil-mixed mortar and concrete containing 10 per cent of oil have very little absorption and under low pressures both are waterproof.

(8) Oil-mixed mortar containing 10 per cent of oil is absolutely watertight under pressures as high as 40 lbs. per square inch. Tests indicate that oil-mixed mortar is effective as a waterproofing agent under low pressures when plastered on either side of porous concrete.

(9) The bond tests show the inadvisability of using plain bar reinforcement with oil concrete mixtures. The bond of deformed bars is not seriously weakened by the addition of oil in amounts up to 10 per cent.

The Houston & Shreveport has let a contract to R. B. Shearer for the construction of a new roundhouse at Shreveport, La.

CONCRETE VIADUCTS AND SUBWAYS.

IN an early issue we will publish an article supplementary to "Concrete Bridges and Viaducts," which was published in the January, 1913, issue. This article will treat of representative overhead highway and track elevation bridges, which we were unable to include in the above mentioned article because of lack of space. It is our aim, with the publishing of this article, in addition to the one in the January issue, to give our readers more complete data, of concrete bridges, accompanied by illustrations than can be found in any other publication.

New Books

CONCRETE COSTS. By Frederick W. Taylor and Sanford E. Thompson; small, cloth, 720 pages; published by John Wiley & Sons, New York. Price, $5.00.

Within the last decade probably more new books have been written relating to the theory, design and construction of reinforced concrete structures, than on any other one engineering subject. However, even with this large number of new books, very little was written regarding the time and cost of labor operations in concrete construction. This new book fills this gap in a most admirable manner, being the result of a most painstaking and laborious study covering a period of seventeen years, by men recognized as authorities in concrete design and construction, and in scientific management.

The first two chapters are given over to approximate costs and cost data on concrete structures. Chapter 3 gives approximate costs of reinforced concrete buildings with curves for estimating, worked up on the same basis as that adopted by Mr. Charles T. Main for mill buildings. The next two chapters deal with the application of scientific management to construction work with a view toward the principal object to be attained, which in the words of the authors, "Is to get the work done right and at the lowest possible cost." These are, without doubt two of the most valuable chapters in the book. Chapters on proportioning concrete, tables of quantities of materials for mortar and concrete, and cost data of concrete materials in tabular form will appeal especially to the contractor to whom they should prove invaluable.

The labor costs of the various labors involved in concrete work, from excavating and crushing stone to the mixing and placing of concrete, are carefully analyzed, tabulated and explained by examples. The chapters on forms, are given mostly to descriptions and illustrations of various types of forms for different structures. Tables of cost of formwork are given in subsequent chapters, which include tables of volumes of concrete in beams, slabs, walls and columns, steel areas and quantities and times and cost of bending and placing steel. A feature which cannot be too highly commended is the folding leaf of directions for using tables which enables the user to have the directions and tables before him simultaneously; this feature should be adopted in all books of such a nature.

The final chapter is an outline of recommended practice in the preparation of estimates and illustrates the use and need of the various tables previously given. The authors have rendered a service to architects, engineers and contractors the value of which cannot be estimated, and every man interested in concrete work should avail himself of the opportunity to read and study this interesting volume.

CONCRETE PRACTICE NO. 6.

Baltimore & Ohio R. R.

The structures illustrated and described herein are in the main those which have been made standard on the Baltimore & Ohio R. R. Concrete bridge floors and reinforced concrete piers, abutments, viaducts and arch bridges are not standard, but are designed to fit local conditions of territory in which they are built. "U" and "T" abutments are used very little except in cases where the local conditions make such an abutment necessary.

Plain Concrete Wing and Straight Abutments.

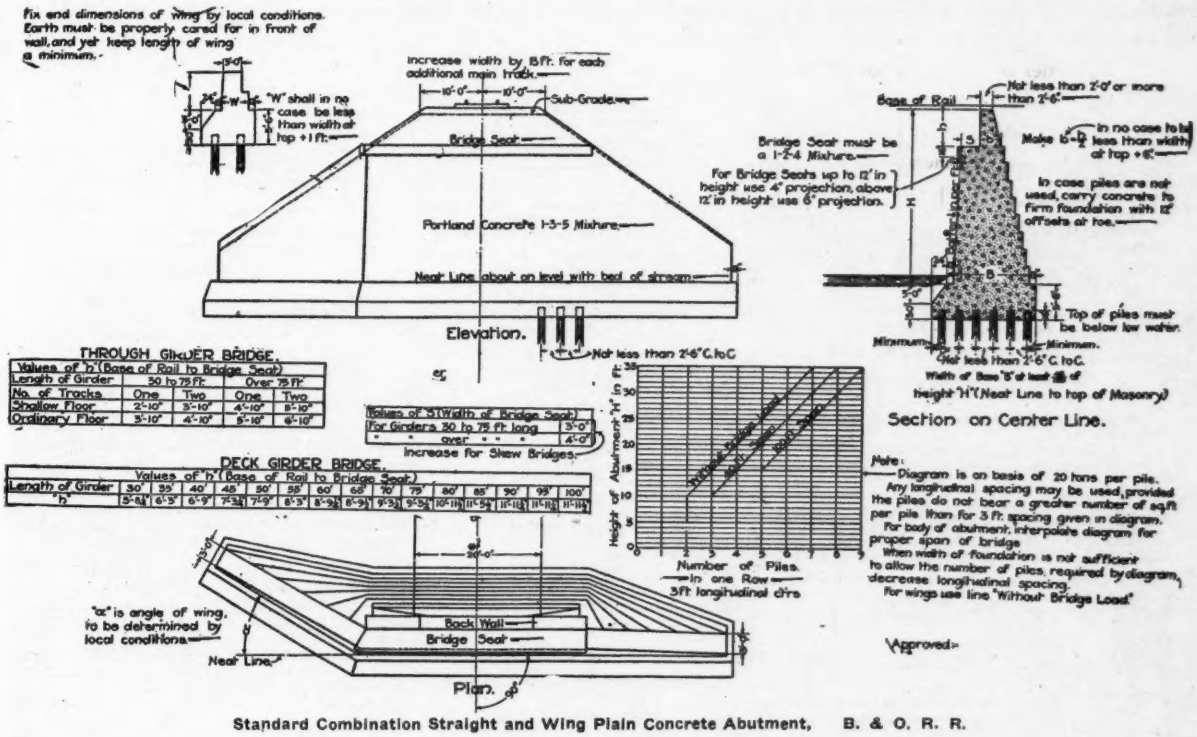
The standard plan for abutments used by this railway is reproduced here. This plan gives the details of construction and complete notes for design.

The concrete used in abutments is a 1:3:5 mixture with clean broken stone, a maximum size of 2 inches, or washed gravel. A 1:2:4 concrete is used in bridge seats and copings.

seat stones are used under girder and truss bearings for all spans over 75 ft., and also for shorter spans when cast iron bolsters are not used.

The wing walls, whether straight or flared, have a top slope of 1½ to 1, so designed that the slope of embankment lies 4 in. below top of concrete. Wing walls have a top width of 3 ft. and a face batter of ½ in. per foot, with the back stepped so that the base is 0.45 of height of wall. The end dimensions are fixed by local conditions, the width of base in no case being less than 4 ft. No provision is made for expansion and contraction between flared wings and the abutment. All exposed edges have a 1¼-in. chamfer.

The forces assumed as acting are Cooper's E-50 live load without impact. The end reaction of trusses or girders is assumed to be distributed 30 deg. with the vertical. Earth pressure on wings and abutment is found by the formula: $F = .286\ wh^2/2$; w = 100 lbs. per cu. ft. and h = height in


Fix end dimensions of wing by local conditions. Earth must be properly cared for in front of wall, and yet keep length of wing a minimum.
"W" shall in no case be less than width at top +1 Ft.
Increase width by 8 Ft. for each additional main track.
Sub-Grade
Bridge Seat
Portland Concrete 1-3-5 Mixture.
Neat Line about on level with bed of stream
Elevation.
Not less than 2'-6" C. to C.
Base of Rail
Not less than 2'-0" or more than 2'-6"
Make b-½ in no case to be less than width at top +6"
Bridge Seat must be a 1-2-4 Mixture.
For Bridge Seats up to 12' in height use 4" projection, above 12' in height use 6" projection.
In case piles are not used, carry concrete to firm foundation with 12" offsets at toe.
Top of piles must be below low water.
Minimum.
Not less than 2'-6" C. to C.
Width of Base "B" at least ⅘ of height "H" (Neat Line to top of Masonry)
Section on Center Line.
Values of "S" (Width of Bridge Seat)
For Girders 30 to 75 Ft. long 3'-0"
" " over " " 4'-0"
Increase for Skew Bridges.
Height of Abutment "H" in Ft.
Number of Piles in one Row — 5 Ft. longitudinal dis
Note: Diagram is on basis of 20 tons per pile. Any longitudinal spacing may be used, provided the piles do not bear a greater number of sq. ft. per pile than for 5 Ft. spacing given in diagram. For body of abutment, interpolate diagram for proper span of bridge. When width of foundation is not sufficient to allow the number of piles required by diagram, decrease longitudinal spacing. For wings use line "Without Bridge Load"
Approved
"α" is angle of wing, to be determined by local conditions.
Back Wall
Bridge Seat
Neat Line
Plan.

THROUGH GIRDER BRIDGE.
Values of "h" (Base of Rail to Bridge Seat)

Length of Girder	30 to 75 Ft.		Over 75 Ft.	
No. of Tracks	One	Two	One	Two
Shallow Floor	2'-10"	3'-10"	4'-10"	5'-10"
Ordinary Floor	3'-10"	4'-10"	5'-10"	6'-10"

DECK GIRDER BRIDGE.
Values of "h" (Base of Rail to Bridge Seat)

Length of Girder	30'	35'	40'	45'	50'	55'	60'	65'	70'	75'	80'	85'	90'	95'	100'
"h"	5'-8½	6'-5'	6'-9"	7'-5½	7'-9"	8'-5"	8'-9½	8'-9½	9'-3½	9'-5½	10'-1½	11'-5½	11'-1½	11'-9½	11'-1½

Standard Combination Straight and Wing Plain Concrete Abutment, B. & O. R. R.

When piles are necessary the thickness of footing is made 5 ft. 6 in., with the top of footing or neat line about on a level with bed of stream. The footing projects 12 in. beyond abutment at neat line, where the width of base is made at least 0.45 of the height from neat line to top of masonry. The number and spacing of piles required is obtained from the diagram, based on a load of 20 tons per pile, with piles 3 ft. centers longitudinally. When piles are not used, the concrete is carried a firm foundation with 12-in. offsets at toe.

The batter of face of abutments is ½ in. in 1 ft. and the back is stepped so as to obtain the required width at the footing. The bridge seat is made 3 ft. wide for girders up to 75 ft. span and 4 ft. wide for longer spans. The top width of abutments has a minimum of 5 ft. 6 in. and varies above this as the height of backwall increases. The backwall 20 ft. long at top has a minimum top width of 2 ft. and a maximum of 2 ft. 6 in. The face is vertical and the back battered so that the width at the bridge seat is equal to one-half the height of backwall, but in no case less than 2 ft. 6 in. The bridge seat coping is made 1 ft. 6 in. deep with a 4-in. or 6-in. projection, depending on whether the backwall is less or greater than 12 ft. in height. Granite

feet, the pressure due to load on bank being added as surcharge.

"U" and "T" Abutments.

"U" and "T" abutments are used only in special cases where local conditions demand the use of such structures. The classes of concrete and forces assumed in design are the same as for straight and wing abutments. For "T" abutments a hollow tail wall is used below the intersection of backs of walls.

Plain Concrete Piers.

The concrete used in piers is a 1:3:5 mix for main body of pier, with 1:2:4 concrete in bridge seats and copings. The forces assumed as acting on the pier are vertical loads only, i. e., weight of pier and load from superstructure without impact.

The footing course projects 1 ft. beyond the neat lines of pier and is carried down far enough to secure a firm foundation. Where piles are required on account of insecure foundation the thickness of footing is made the same as for abutments.

The top width of the pier shown is 8 ft. under coping, which has a 6-in. projection. This top width is standard for

structures (on tangent) of over 75 ft. span, a width of 6 ft. is used for spans of less than 75 ft. The above width is varied on skewed piers or where the bridge is on a curve. The batter of sides and ends of pier is ½ in. per foot, making the width of base about 0.35 of the height above the footing. The up-stream end of pier has a 45-deg. starkwater extending the full height with a length of 4 ft. parallel to the longitudinal center line of pier, with same batter as remainder of pier. This starkwater is of plain concrete and the point is not protected in any way. The bridge seat is 9 ft. wide and 1 ft. 6 in. deep, projecting 6 in. beyond pier. The top of pier is 46 ft. 6 in. long under coping, being designed as a three-track structure. All exposed edges have a 1¼-in. x 1¼-in. chamfer, except coping, which has a 2-in. x 4-in. wash.

Plain Concrete Arch Bridge.

The double-track concrete arch bridge, details of which are shown here, is not a plain concrete arch, since enough reinforcement is placed in the arch ring to prevent cracks due to unequal loading and settlement. However, it cannot be called a reinforced concrete arch in a true sense.

The forces assumed in design are 150 lbs. per cu. ft. for concrete and 100 lbs. for earth as dead loads and a live load of 1,000 lbs. per sq. ft., assumed to be equivalent to Cooper's E-50 loading without impact. The concrete used in the entire structure is a 1:3:5 mixture, allowable stress in concrete being 500 lbs. per sq. in. compression.

The abutments and wing walls are built on piles spaced as shown on plans and cut off 18 in. above the bottom of footings, which are 4 ft. thick. The backs of abutments have a batter of 2 in. to 1 ft. The 30-deg. wing walls have a top width of 2 ft. 6 in. and a face batter of ½ in. per foot, the back being stepped so as to secure a width of base equivalent to 0.45 of the height. The top slope of wings is made the same as slope of fill, i. e., 1½ to 1.

The circular arch ring is 35 ft. 6 in. wide with a crown thickness of 2 ft. 1 in. The radius of the intrados is 15 ft. and that of extrados is 30 ft. to a point 13 ft. above the footing, where the extradosal line intersects the back of abutment.

The arch ring is reinforced transversely only, with ¾-in. round bars on 12-in. centers, 3 in. above intrados, extending below springing line. The same amount of reinforcement is placed in the extrados. This reinforcement is bent down at a point about 10 ft. on each side of the center line of arch so as to double the amount of reinforcement at the intrados at the crown of arch. This amounts only to about 0.3 per cent reinforcement at the crown.

The spandrel walls are plain concrete gravity walls with a top width of 3 ft. over coping, which is 1 ft. 1 in. deep and projects 6 in. beyond the arch ring. The top of coping has a 2-in. x 4-in. wash on the outside and ends. The height of spandrel at the crown is 6 ft. above the intrados of arch. At this point the filling for subgrade is 2 ft. 4 in. deep with 1 ft. 7 in. of ballast for finished track.

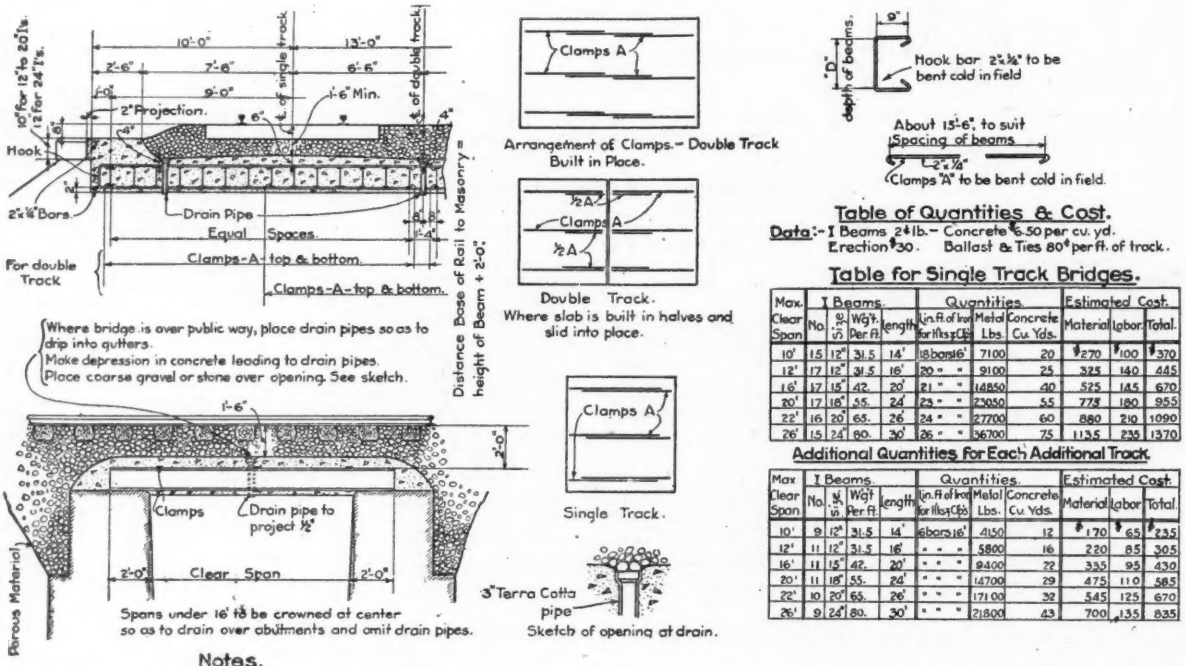


Table of Quantities & Cost.

Data:- I Beams 24 lb.- Concrete $6.50 per cu. yd. Erection $30. Ballast & Ties 80¢ per ft. of track.

Table for Single Track Bridges.

Max. Clear Span	I Beams No.	I Beams Wt.	I Beams Wgt. Per Ft.	I Beams Length	Quantities Lin. Ft. of Iron for Hks. & Obs.	Quantities Metal Lbs.	Quantities Concrete Cu. Yds.	Estimated Cost Material	Estimated Cost Labor	Estimated Cost Total.
10'	15	12"	31.5	14'	18 bars 16'	7100	20	$270	$100	$370
12'	17	12"	31.5	16'	20 " "	9100	25	325	140	445
16'	17	15"	42.	20'	21 " "	14850	40	525	145	670
20'	17	18"	55.	24'	23 " "	23050	55	775	180	955
22'	16	20"	65.	26'	24 " "	27700	60	880	210	1090
26'	15	24"	80.	30'	26 " "	36700	75	1135	235	1370

Additional Quantities for Each Additional Track.

Max Clear Span	I Beams No.	I Beams Wt.	I Beams Wgt Per Ft.	I Beams Length	Quantities Lin. Ft. of Iron for Hks. & Obs.	Quantities Metal Lbs.	Quantities Concrete Cu. Yds.	Estimated Cost Material	Estimated Cost Labor	Estimated Cost Total.
10'	9	12"	31.5	14'	6 bars 16'	4150	12	$170	$65	$235
12'	11	12"	31.5	16'	" " "	5800	16	220	85	305
16'	11	15"	42.	20'	" " "	9400	22	335	95	430
20'	11	18"	55.	24'	" " "	14700	29	475	110	585
22'	10	20"	65.	26'	" " "	17100	32	545	125	670
26'	9	24"	80.	30'	" " "	21800	43	700	135	835

Notes.

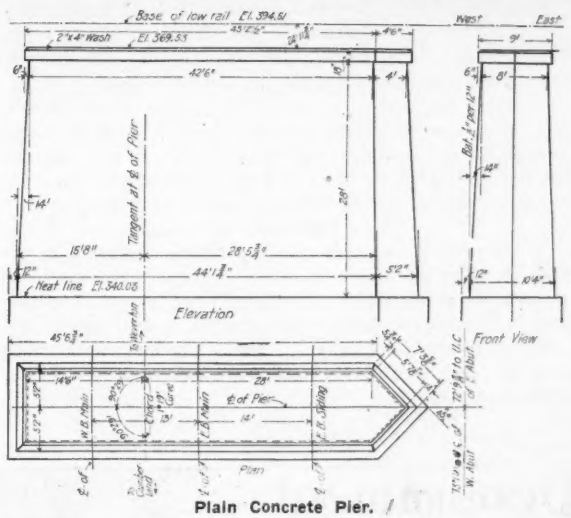
12 Clamps "A" for single track. 18 Clamps "A" for double track.
Hooks spaced 3ft. apart on outside of I beams. - Drain pipe to be terra cotta pipe.
4-2"x¼" bars- Length 1ft. greater than length of I beams for any number of tracks. Bars to lap 3ft. where more than one bar is needed to make length required.
When depth of filling over concrete exceeds that [illegible] slopes and increase number of I beams in proportion.

Standard I-Beam Bridges and Culverts, B. & O. R. R.

Concrete Slab Floors for Deck Girder Spans.

The slab floor shown is used for ballast floor deck girder spans only, and is made of 1:2:4 concrete reinforced with deformed bars of medium steel. Cooper's E-50 live load without impact is used in design. Unit stresses allowed in design are 16,000 lbs. per square inch tension in steel and 500 lbs. compression in cross-bending for concrete.

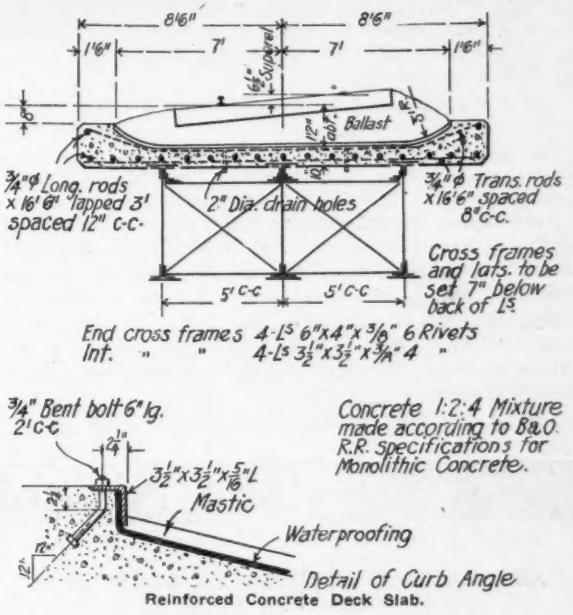
The slab has a thickness of 10 in. between girders, the portion of slab (3 ft. 6 in.) projecting over girders increases in thickness in a gradual curve until at the parapet, 19 in. wide, it is 1 ft. 4 in. thick. The transverse or main reinforcement consists of ¾-in. round bars 16 ft. 6 in. long, spaced 8-in. centers in top and bottom of slab. The bars in top stagger with those in bottom of slab. The top bars are bent up into top of parapet. The longitudinal reinforcement is of ¾-in. bars 12-in. centers in bottom, lapped



Plain Concrete Pier.

3 ft. at splices. One ¾-in. bar is placed longitudinally in top of parapets near outer edge.

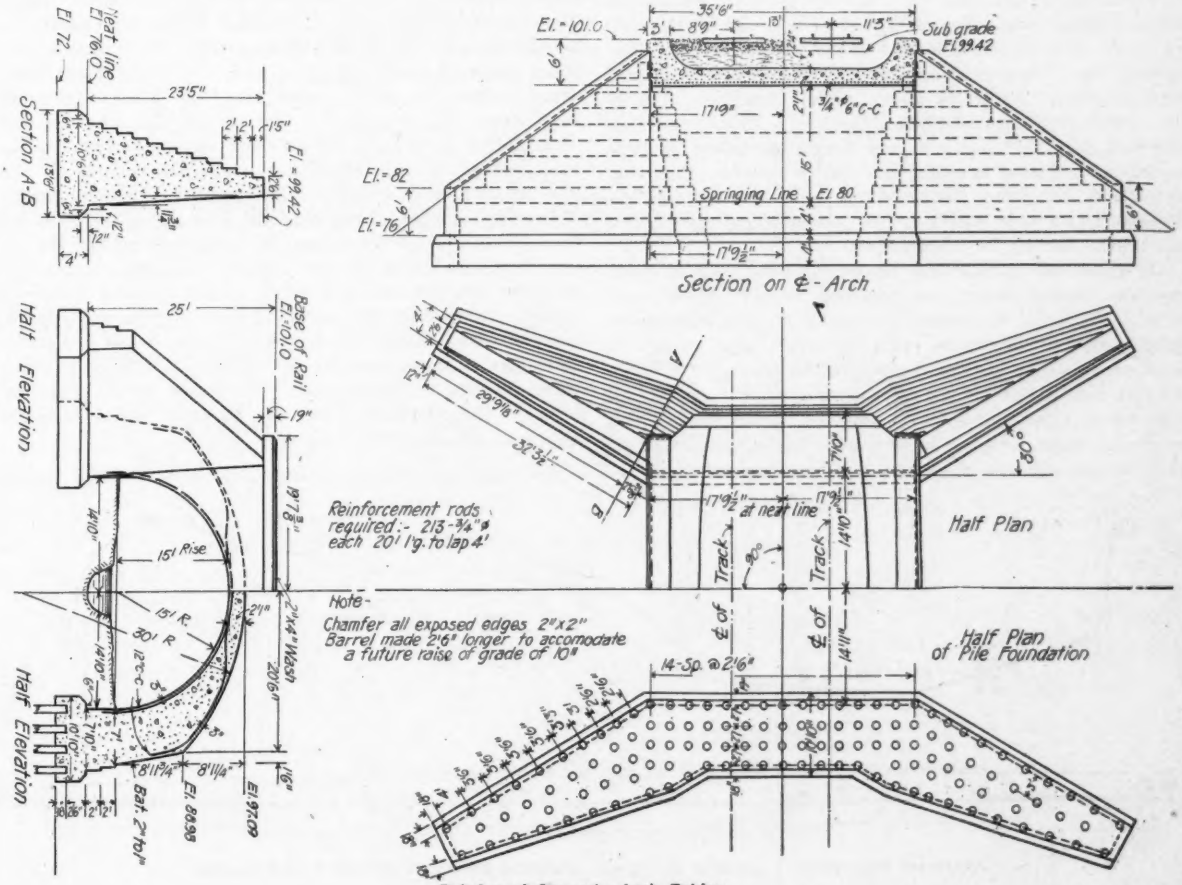
The inner edges of parapets or curbs are protected by a continuous 3½ x 3½ x 5-16 in. angle bolted to concrete and acting as a flashing for waterproofing. The slab is waterproofed by the membrane method with felt and mastic. Drainage is afforded by 2-in. diameter holes placed about 10-ft. centers, in middle of slab between girders. A minimum thickness of 15 in. is allowed for ballast on these floors. These slabs are erected at the site, to one side of bridge, and rolled into place when sufficiently seasoned and hardened.


8'6"
1'6"
7'
Ballast
¾"ϕ Long. rods x 16'6" lapped 3' spaced 12" c-c-
2" Dia. drain holes
¾"ϕ Trans. rods x 16'6" spaced 8" c-c.
Cross frames and lats. to be set 7" below back of Ls
5' c-c
End cross frames 4-Ls 6"x4"x⅜" 6 Rivets
Int. " " 4-Ls 3½"x3½"x⅜" 4 "
¾" Bent bolt 6" lg. 2'c-c
Mastic
Waterproofing
Detail of Curb Angle
Concrete 1:2:4 Mixture made according to B&O. R.R. specifications for Monolithic Concrete.

Reinforced Concrete Deck Slab.

Concrete Metal Bridges.

For culverts and bridges of short span, including cattle passes, this road uses a combination concrete and steel I-beam floor slab on concrete abutments. These bridges are designed for spans of from 10 to 26 ft. in accordance with the standard sheet reproduced herewith. In general, the depth of ballast over concrete is about 18 in., but in cases where



Reinforced Concrete Arch Bridge.

the depth of filling is greater the bridge is widened to take slopes, and the number of I-beams is increased in proportion to that shown in tables which give the number of I-beams required for various spans.

The I-beams project 2 ft. upon abutments and have a protection of 2 in. of concrete at the bottom. At the center line of track the thickness of concrete over the I-beams is 6 in., sloping to 4 in. at the parapets, where 3-in. terra cotta drain pipes are placed. The I-beams are placed on the concrete abutments and clamped together with clamps "A" of 2-in. x ¼-in. steel bars, bent as shown in detail. These clamps are placed at ends and center of span. The sides of slabs are thicker to form a curb or parapet 2 ft. 6 in. wide with a coping 10 to 12 in. deep projecting 2 in.. The parapet is reinforced with a 2-in. x ¼-in. longitudinal bar at top and bottom near face. The ends of slab are rounded off to meet the top of abutments.

The tables of quantities and estimated cost of these structures for various spans are reproduced herein, the cost being based on steel at 2c per lb., concrete at $6.50 per cu. yd., erection $30 and ballast and ties 80c per ft. of track.

The concrete used in the slabs is a 1:2:4 mixture, with ¼-in. to 1-in. stone as the coarse aggregate. The live load used in design is Cooper's E-50 with 50 per cent impact. The top surface of concrete is waterproofed with some approved compound before ballast is placed on slab.

Comment.

The structures described and illustrated indicate that the B. & O. R. R. uses plain concrete and structural steel and concrete in combination to a very large extent, but uses very little reinforced concrete except in special cases.

We are indebted to Mr. F. L. Stuart, chief engineer, Baltimore & Ohio R. R., for plans and data from which this article was prepared.

The Signal Department

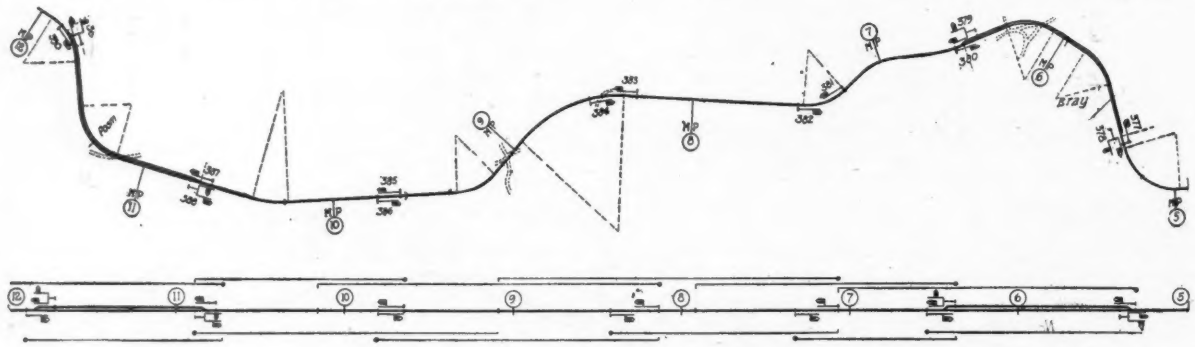
AUTOMATIC BLOCK SIGNALS, NORFOLK & WESTERN RY.

The automatic block signals recently installed and put into service by the Norfolk & Western Ry. have a number of interesting features.

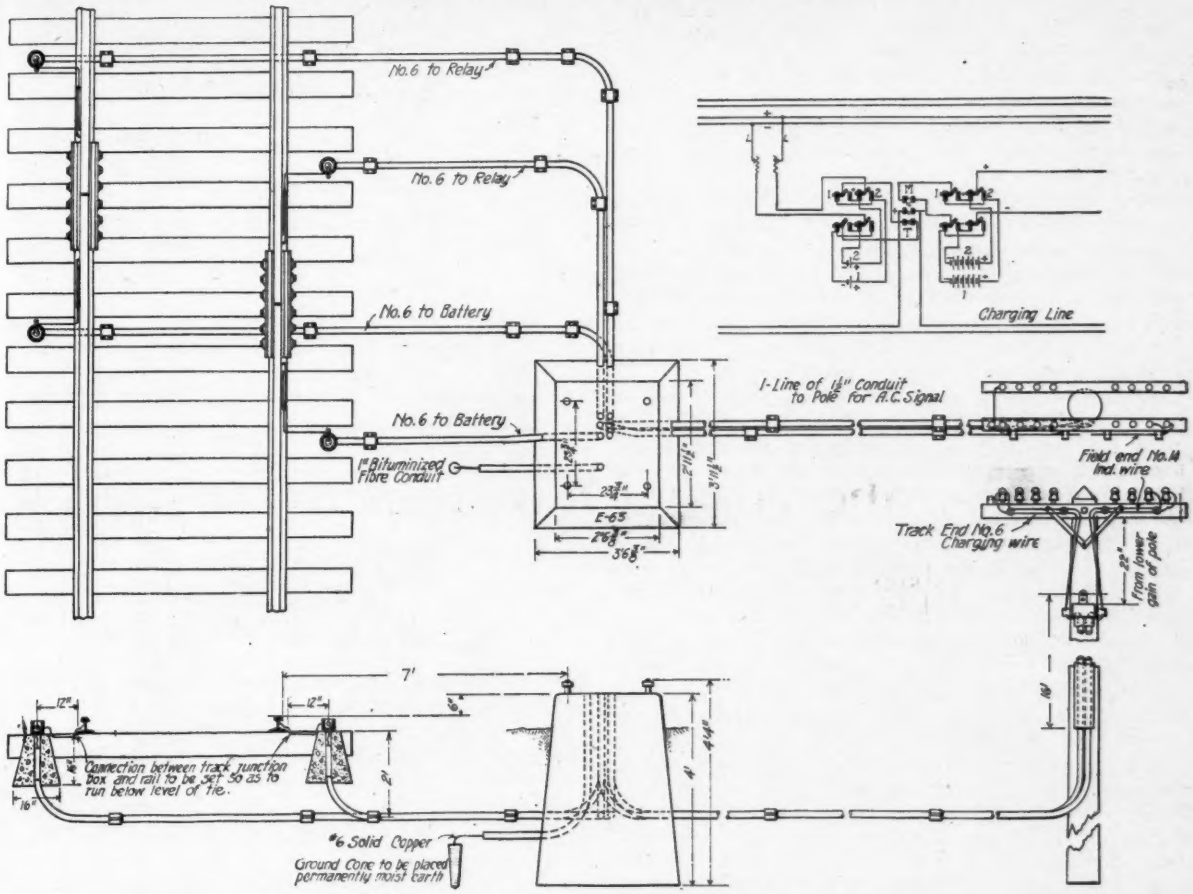
On June 15 and September 1, 1912, the automatic block signals on two stretches of single track road were put into operation. The first, a 22.5 mile section, is between Forest, Va., and Phoebe, Va. The second, a 11.2-mile section, is between Jack, Va., and Estes, Va. The signals on both sections are operated by direct current, including the track circuits. The installation of these signals was followed by that of a stretch of 17 miles of double track automatic block between Suffolk, Va., and Gilmerton, Va. Alternating current is used for both track and signal circuits. As stated above, direct current is used in the single track installations. Herein, a departure from standard practice, as far as the source of power is concerned, will be noted from the fact that in the first case, track, signal, and line circuits are fed from storage battery, while in the second case, soda battery is used for signal and line circuits, and gravity battery for track circuits.

All signals are normal clear semaphore, three position upper quadrant, electric motor type, operating from 0° to 45°—45° to 90°. The signal mechanisms are located at the bottom of the signal masts, in mechanism cases, which are large enough to house the operating battery wherever battery is used. On single track all signals between stations, including inbound signals, are mounted on ground posts; while outbound signals are mounted on bracket posts. It is well to note here, that at each end of all stations, two outbound signals are located at the fouling points; mounted on bracket posts, as stated above. The inbound signals are located within a few feet of the head block. Referring to the typical signal layout showing the signal locations on single track, the method of locating signals between stations will be clear. The overlap scheme for the single track is shown in the typical straight line layout for single track blocking. It will be seen that the signals for one direction have the short overlap while those for the other direction have the long overlap. That is, the signals having the short overlap govern to the second opposing signal while those having the long overlap govern to the first cut section in advance of the second opposing signal. This scheme of overlapping is sometimes used to good advantage in train spacing, for up and down grade. For example: the short block is used up grade and the long block down grade; while on level grades the long blocks are used both ways. The overlap for the inbound signal at one end of a station extends to the inbound opposing signal, while the overlap for the other inbound signal extends to the first cut section in advance of the opposing inbound signal. However, if either of the head block switches are lined up for a move out of the siding, then the overlap for the inbound signal for which the switch is trailing, is cut out and that inbound signal governs to the advance outbound signal. Both outbound signals govern to the same point, one of which, controls main line moves while the other takes care of moves from the side track. The position of either blade depends, of course, upon the position of the main line switch. The above conditions can be easily traced from the typical circuit plan shown herewith.

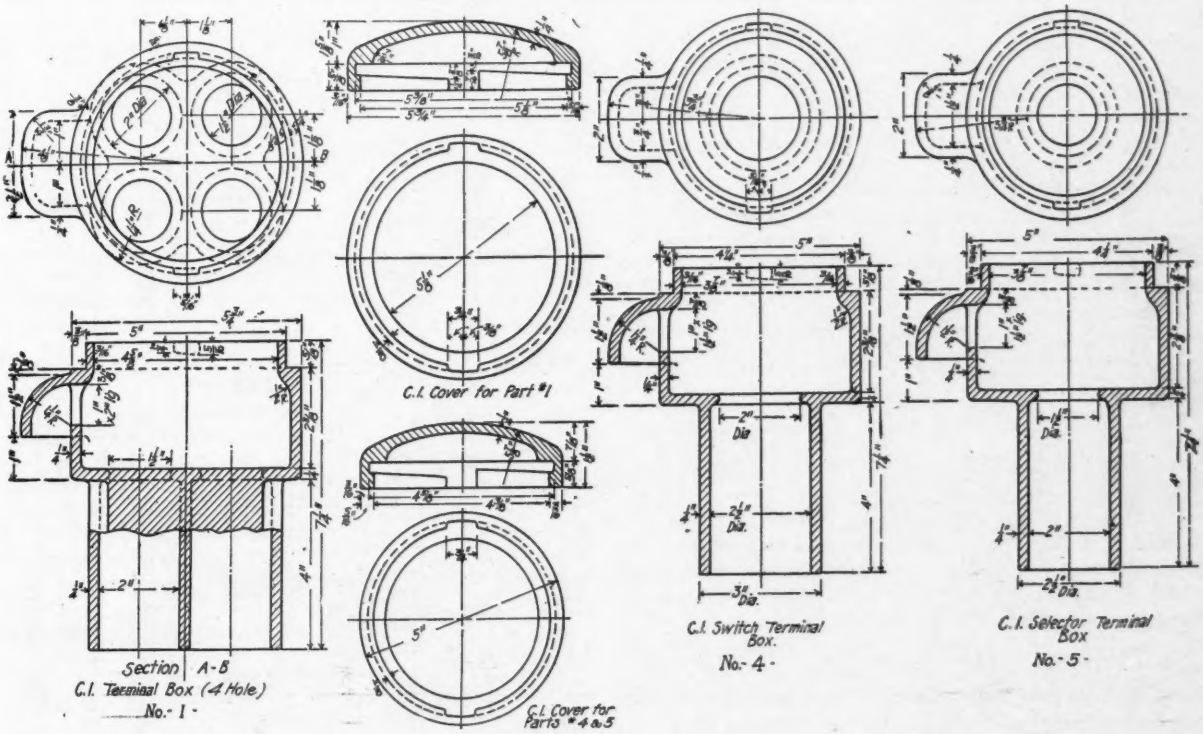
The night color indications are: clear, white; caution, green;



Alignment Plan Showing Location of Signals. Overlaps Shown on Straight Line Projection.


No.6 to Relay
No.6 to Relay
No.6 to Battery
No.6 to Battery
1" Bituminized Fibre Conduit
E-63
1-Line of 1½" Conduit to Pole for A.C. Signal
Charging Line
Field end No.14 Ind. wire
Track End No.6 Charging wire
22" from lower gain of pole
7'
12"
12"
Connection between track junction box and rail to be set so as to run below level of tie.
#6 Solid Copper Ground Cone to be placed permanently moist earth

Plan and Section of Wire Duct Layout, and Circuit for Battery Charging.



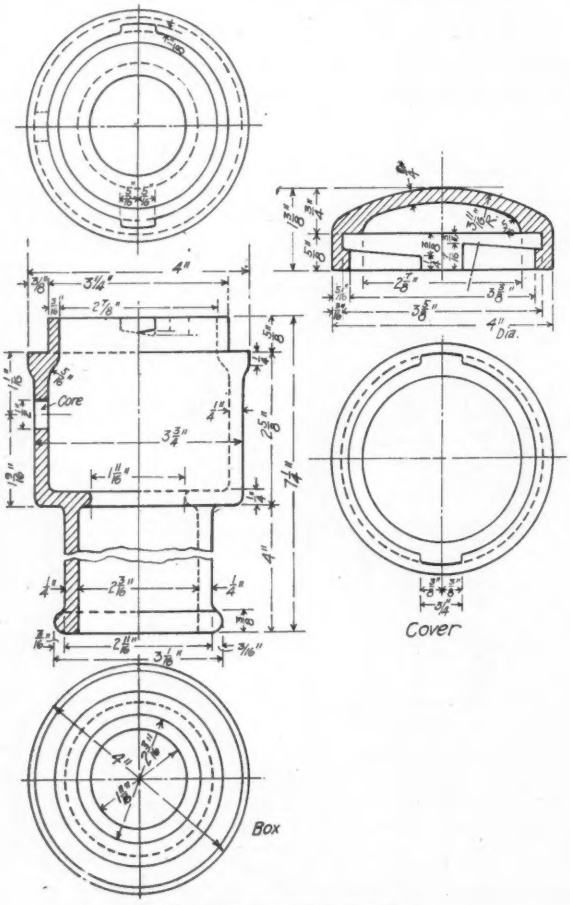
Cast Iron Terminal Boxes.

stop, red. The day indications are displayed by the blade; diagrams of which appear here.

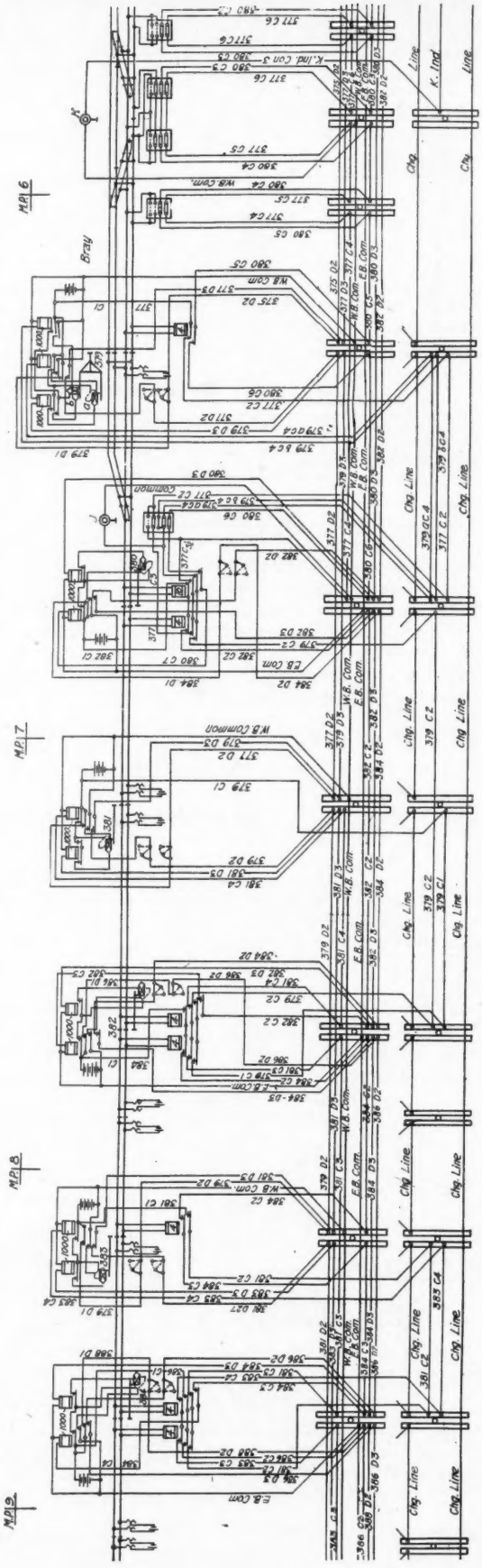
The long blade is used with the style "B" U. S. & S. Co.'s signal and the short blade with the style "S" U. S. & S. Co.'s signal. The blades are made of porcelain enameled iron, pressed and cut into the shape shown. The front and edges are painted vermillion, the back black.

Switch indicators are used at all main line switches. At night they are illuminated wherever power is available, as is the case on the double track where alternating current is used; and also on the section of single track where the storage battery charging line furnishes the power for illuminating purposes. Two 2-c. p., 10-volt Tungsten lamps are used on the direct current signal work, and one 2-c. p., 110-volt Corban lamp where alternating current is available for signal lighting.

On the direct current single track signal layout the track relays are wound to 4 and 16 ohms. The 4-ohm relays are used on the long track sections, and the 16-ohm relays on the short ones, which occur in general between the inbound and outbound signals at stations. All line relays are wound to 1,000 ohms. The battery end of track circuits, where storage battery is used for track circuit current, is fitted with two variable resistance units with a maximum resistance of 5 ohms. The object of the resistance is to protect the storage battery from a direct short circuit when a train is occupying the track section. A diagram of the circuit used for battery charging is shown herewith. The storage battery for track circuit work consists of one cell in duplicate for each track section. The storage battery for signal operation and line control consists of five cells in duplicate. The charging line is strung on the same pole line with the signal circuits, No. 4 B. & S. copper wire is used for the former and No. 10 B. & S. copper clad for the latter.



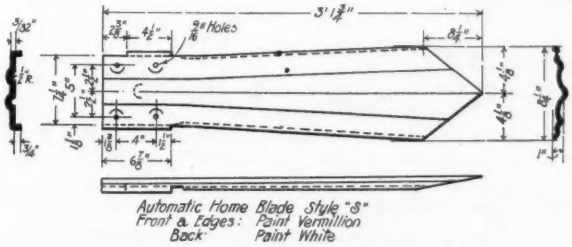
Bootleg Cast Iron Junction Box.



Typical Single Track Automatic Block Signal Circuit.

The single-track signal circuits shown are typical, and show the independent common return wires, without any breaks, for both directions. This requires either more line wire for control circuits, or else more battery. For these installations the result was in favor of the line wire. On the other hand, it is stated that for the double track alternating current signal work, return common is not used except where indicator circuits occur.

The principal apparatus used on the alternating-current signal work for a signal location is given in the following: A 110-volt, 3-position, a. c. signal, controlled by a galvanometer type a. c. relay, having a field coil wound for 110 volts, and track coil wound for .5 volts; also a vane type slow acting relay wound for 110 volts; two reactance coils for track circuit



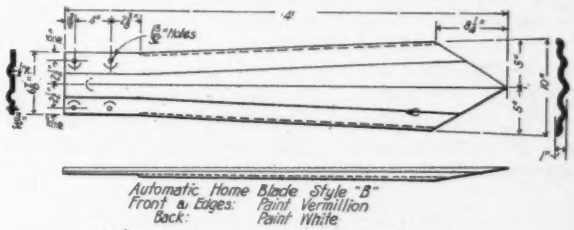
Automatic Home Signal Blade, Style "S."

purposes are used and a single-phase transformer with primary winding for 4,400 volts, secondary windings for 110 volts and 10 volts. On both the double and single track work Brach lightning arresters and Paragon ground cones are used. The cast iron terminal boxes, illustrated herewith, are used for the different layouts.

The transmission line consists of No. 6 B. & S. copper wire, and the control circuit for signals is No. 10 B. & S. copper clad. The voltage of the transmission line is 4,400, with a frequency of 25 cycles. The control circuits are 110 volt, 25 cycle, and the track circuits are 6 to 10 volts at 25 cycles.

The diagram showing the wire duct layout at signal locations, illustrates the method used in all three signal installations for running the wires from the track and pole line to the signal location. All ducts for wire, except those running up the pole to the cast iron junction boxes, are below ground, and consist of fibre conduit. At the track ends cast iron boxes are used to serve as bootlegs. Each bootleg has a separate run of conduit to the signal locations.

The following grades and sizes of wire were used for local



Automatic Home Signal Blade, Style "B."

wiring purposes: Bootlegs, No. 6 galvanized iron; leads from track, No. 9 B. & S. copper rubber covered flexible; leads from battery, No. 6 B. & S. copper rubber covered flexible; and leads from line, No. 14 B. & S. copper rubber covered solid.

The above system of signals was installed under the direction of D. W. Richards, signal engineer of the Norfolk & Western Ry., to whom we are indebted for the information and illustrations given herein.

The Maintenance of Way Department

ROADMASTERS AND MAINTENANCE OF WAY ASSOCIATION.

Owing to the fact that probably a large number of roadmasters will attend the exhibit of the National Railway Appliances Association at Chicago, March 15-21, the Roadmasters' and Maintenance of Way Association will occupy booth 288 at this exhibit.

William Shea, president; L. C. Ryan, secretary, and A. M. Clough, past president, will be among those at the booth. All roadmasters attending, whether members of the organization or not, will do well to visit this booth during the show, and meet the officers.

TRACK LABOR.

Editor Railway Engineering:—

I have been reading, in the recent issues of your paper, the opinions of many men on the labor question, and future supply of foreman, and would like to give my opinion with respect to these questions.

Do not discard old experienced foremen (even if they have reached the age of 65 years), and hire young, inexperienced, unmarried men. Do not turn down an applicant who is 45 years old, if he is capable, for if so, he will probably give you excellent service for 20 years.

The railways seem to want only the most able bodied men for foremen, such as the government requires for sailors and soldiers. Instead of this they should look for men of intellect, for brains are necessary in coping with problems that confront the trackman.

On many an eastern road the requirements for foremen are so low that a young, bright lad is unable to learn anything from most of them.

Bright, intellectual young married men should be hired and trained for foremen, but they should be placed under a competent foreman and watched and encouraged by the supervisor. It is easy to tell if such students or apprentices are receiving proper training, by asking a few questions of them from time to time.

In all trades there are rules and methods for laying out work so that it will be perfect when completed. Trackmen should be tradesmen, but it is my opinion that few are, at present. Of course, much of track construction cannot be reduced to exact methods, and much must be left to the foreman's judgment. Fred S. Kimball.

RAIL RAVELINGS.

Dear Son:—

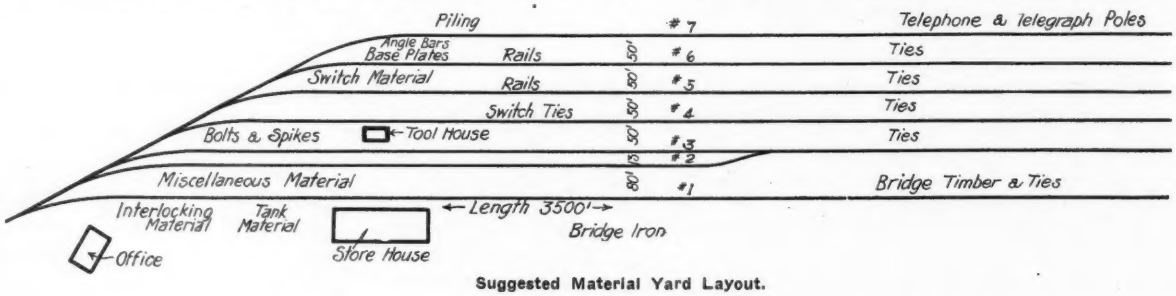
Not long since I was somewhat surprised to receive a call from two General Officers of one of the big trunk lines. They were a couple of hundred miles from their road looking for plans and information for the building of a material yard to handle material for the construction of a new line. Thinking you might be confronted with a like problem on construction work some time I will send you a plan for a material yard with a few "pointers."

There are many things to take into consideration in laying out a material yard, viz., the amount and kind of material to be unloaded and piled, number of cars to be handled and so forth. A great deal also depends on the location and the nature of the ground. When suitable ground

can be obtained the accompanying plan will afford room for rail, ties, spikes, bolts, angle bars, switch material, crossing plank, piling, bridge timber, steel girders and spans, tank material, telegraph and telephone poles and material, and all miscellaneous material necessary for the construction of 100 miles of road through a prairie country.

The accompanying sketch will give you an idea of the plan I have in mind. This plan may be further developed by the addition of a ladder track where I show stub tracks. or curtailed by making smaller. If the full ladder is not used at least one track, preferably No. 3, should be connected with the main line, when material is being loaded out for track laying and general construction work.

The idea of connecting No. 2 with No. 3 is to provide a run around track, and the centers being 13 feet affords good opportunity for transferring material from one car to another when occasion arises. Ground that is gently rolling is preferable to that which is perfectly level, as it affords better drainage. Very little grading is necessary for the tracks as a rule; simply level off for the ties. The track running over the little raises in the ground will work



Suggested Material Yard Layout.

no material damage. To provide drainage for tracks, dig small ditches near end of ties using the dirt to surface the tracks.

In piling ties the ground should be measured off and the piles located so that when a string of box cars are spotted for unloading, a pile will come opposite each door; the first two piles should be two or three feet apart, the next space or alley should be four feet wide to provide room for water barrels for fire protection, and so on through out the yard, every alternate alley being wide enough for water barrels. Ties may be piled 25 high at the end where racked up, sloping the pile toward the car to give a footing for the men when unloading and piling.

In piling rail, care must be taken to have the foundation solid to prevent the pile from sagging and bending the stringer or skid rails. The piles of rail should be as wide as the standard length of rail used so that full length rails may be used for skids. It is perhaps unnecessary to say that rail should be handled with a derrick, both in unloading and hoisting, and that is the practice in all first class yards.

All material should be piled with a view to quick loading when the time comes to send it to the front, as there is always more time to handle material when it is being unloaded and stored than when loading for construction. You will readily understand from some of our experiences when we were working together that there can be no set plan for a material yard that will apply at all times and under all conditions. But having a general idea something like the one I am suggesting may help you out, if the time comes that you will be called upon to take charge of construction work.

I have outlined or assigned space in a general way for the piling of the different kinds of material, but the disposition of material in a yard will be largely governed by the local conditions existing on each piece of construction.

If you are called on to take charge of a material yard, you want to realize that it is an important position. It is hard to find a man capable of filling properly this position.

In loading material for the front as much pains should be taken as you took when loading dimension stone in courses for abutments and piers during one of your early experiences, so that everything may be unloaded quickly and as easily as possible.

The loading of material for a track laying machine requires a man who is perfectly familiar not only with the material to be used but also with the method of handling it with the machine. The above pointers should be enough to start you right, after which success will depend on your own efforts.

DAD.

DON'TS FOR THE TRACKMAN.

J. G. Wishart, C., R. I. & P. Ry.

In these days when the "Safety First" and "Save a Nickel a Day" mottoes are receiving such marked attention, the trackman who observes the appended list of "Don'ts" will go a long way towards performing his share of the accident prevention and economy production.

1. Don't trust to a red flag unless you can see it. Someone may have stolen it.
2. Don't obstruct track in the face of a passenger train.
3. Don't put your track jack between the rails.
4. Don't shim track with wood or temporary material.
5. Don't surface your track down hill if you can avoid it.
6. Don't raise your track more than necessary at summit of grades.
7. Don't take out ties that are serviceable.
8. Don't leave your tools out on the section for tramps and train wreckers.
9. Don't leave spikes or track bolts where they can be placed on outside of rail on curves by children playing in the neighborhood.
10. Don't use a briar scythe where you should use an axe or bushhook.
11. Don't cut grass with a bushhook.
12. Don't use a tamping pick after the head has been practically worn off.
13. Don't burn your ties in the evening and leave the fire when you go home at night.
14. Don't send one man over the track to tighten up joints; he won't do it. Take the whole gang and get it done.
15. Don't leave overhanging rocks in cuts or tunnels that you know should be removed.
16. Don't leave a broken rail because it matches up perfectly. Remove it from main track and before using again saw off broken ends and drill for angle bars.
17. Don't smooth the track and forget to line it. Bad line will jerk a train worse than low joints.
18. Don't use a bad lever in a handcar. It will break when you want it to hold, and is liable to cause an accident.

19. Don't leave a switch point that does not fit up perfectly.
20. Don't permit a spring rail frog to remain with the point spread open.
21. Don't leave crossing plank projecting above the top of rail.
22. Don't leave broken angle bars in the track.
23. Don't leave your hand car on a crossing where it will frighten horses.
24. Don't leave bolts in the rain, where they will get rusty.
25. Don't leave your tools along the road, where they can be stolen.
26. Don't dig a ditch and then throw the dirt where it will wash back into it when it rains.
27. Don't ballast track where the roadbed is not wide enough to hold it.
28. Don't leave dirt or foul ballast where it will hold water under the ties.
29. Don't try to draw a rail with a spike—hold it to gage with a bar and drive the spikes straight.
30. Don't carry non-employees on your cars.
31. Don't trust to a red flag without torpedoes; you may need the shells to prove you had a flag out.
32. Don't waste dirt in a cut that you know should be put on the adjoining fill.
33. Don't leave ties unspiked.
34. Don't go to work without your level and gage.
35. Don't leave your car and tools around station platforms, where they will obstruct travel.
36. Don't leave your section without permission from your superior.
37. Don't allow ballast to roll down the bank or lie in ditches.
38. Don't let new ties roll down the bank when distributing them.
39. Don't throw steel rails off cars in such a manner as to bend them. They should either be skidded off, or dropped flat, where they will not fall on other obstructions.
40. Don't allow your men to wear red garments when on duty.
41. Don't hang your clothes on the roadway signs.
42. Don't use dangerously defective cars or tools.
43. Don't use bent spikes for track bolts.
44. Don't guess at the number of ties put in track each month. Count them.
45. Don't guess at the rail on your section. Measure it.
46. Don't be disrespectful to owners of land adjoining the right of way. Remember they are your neighbors.
47. Don't permit material or buildings to be placed too near the track.
48. Don't put wedges and shims between principal members of trusses.
49. Don't try to support a plate girder at an unbraced flange.
50. Don't let the nuts work off hook bolts of stringers and off guard rails.
51. Don't force rivet holes where they should be reamed.
52. Don't join members of iron bridges without first painting them.
53. Don't allow drift to accumulate at the ends of piers.
54. Don't allow tin roofs to be destroyed for the want of a little paint.
55. Don't take out too many ties and allow the track to kink in hot weather.
56. Don't fill in with ballast when the ties rest on dirt.
57. Don't make ballast margin when you have not enough material to fill in between the ties and thoroughly tamp them.
58. Don't nick, slot or dent steel rails.
59. Don't place rails in curves sharper than two degrees without first curving them with a rail bender.
60. Don't allow the gage of track at frog points to vary from the standard without correspondingly adjusting the flangeway of the guard rail.
61. Don't allow your right of way fences to become dilapidated and allow stock to enter upon the right of way.
62. Don't fail to fill out all your reports carefully and intelligently; these reports are required for a purpose.
63. Don't guess at data for your broken rail reports. Read what is marked on the rail.
65. Don't allow farm gates in the right of way fence to stand open.

LABOR CONDITIONS AND REMEDIES.

C. L. V.

The task of obtaining suitable men for track work on railways, where only the lowest wages are paid for laborers, is an exceedingly difficult one and within the last few years the difficulties encountered in this line have increased alarmingly.

Conditions have become such that at the present time it is almost impossible to secure experienced track laborers at the wages offered by the large railway systems; and engineers and foremen in charge of construction are confronted with the problem of how best to get work done with the labor available.

In the laboring classes, there are men suitable for railway construction work. Contractors realize this, and therefore offer better wages than railways pay and thereby get the better laborers in the end, as the "weeding out" process is available when good wages are offered. We have left, then, for railway construction, inexperienced men, and men who cannot "make good" with the contractors. A large per cent of the former are foreigners and some of these are of the lowest type. The latter may, under a competent foreman, develop into satisfactory laborers from the point of view of efficiency as attained by railways, which, as we know by comparison of jobs and unit prices, does not compare with the contractors' standards of efficiency.

To add to these difficulties, laborers must be obtained through labor agencies except for work in or near large cities. In order to get his fee for getting a laborer a job, a labor agent will almost invariably misrepresent conditions and offer inducements that the railway companies have not agreed to and will not concede. This fact at the very start, lands men on the work dissatisfied and in an antagonistic mood, as most foreigners believe that the labor agent is an official of the railway company.

Men are also led to believe that the money they have paid out for their jobs entitles them to do as they please and cases arise when they openly defy the foreman to discharge them. Such conditions are a big detriment to the railway company and if railways are to do their own construction at reasonable prices, some measures must be adopted to remedy the laboring conditions.

In order to secure good workmen, with the demand for laborers as it is at present, railway companies will have to approach the scale of wages, paid by contractors for similar work. This they erroneously refuse to do.

Responsibility for this error of judgment must be placed upon officials who have final authority in adopting the scale of wages. These men usually sit at a desk in the general offices and know little or nothing whatever of actual outside working conditions and details.

Occasionally these officials shift the responsibility upon the directors of the company, but the official who cannot convince the directors as to the economy of higher wages for laborers when unit costs for contractors are available for comparison, is still at fault.

Having an equal show with other concerns of obtaining good workmen, the railway company can then force the labor agencies to furnish men at a reasonable fee and give labor

agents to understand that they will tolerate no misrepresentation of facts and conditions. There is plenty of competition among agencies, and if any one concern failed to comply with orders, a satisfactory substitute could readily be located. In this manner agencies could be compelled to furnish foreign gangs without interpreters who are detrimental in any gang. (The writer has handled foreigners in all stages of development and is thoroughly convinced that, even in gangs which came directly from foreign countries without any American ideas or words, an interpreter is a positive detriment.)

Occasionally a labor agent may send a foreman of the same nationality as the gang. These men are desirable, if they are good experienced track men and are not inclined to be easy on men just because they are their nationality.

Necessarily a gang of foreigners without an interpreter must have a foreman who thoroughly understands handling foreigners. He must also be capable of handling the work given him to do. He must have an assistant unless the gang is small, but even with an assistant he must not be given charge of more men than he can watch, for foreign labor requires continual vigilance, and the foreman usually has to supply the brains for each and every move.

The question of proper treatment of men by the foreman is discussed a great deal. Is it better to "drive" men and keep them in a state of constant fear, or is it better to treat them considerately, thus gaining their good will and then hurry the work through with men in a brighter mood? The latter has been found the better way in most cases, by the writer, as a gang treated this way usually maintains the "speed" which the foreman sets himself. Of course this means work for the foreman. The lazy foreman would prefer the former method of "driving" the men by swearing at them and abusing them with an overflow of profane epithets.

Of course, a foreman must not be lenient with foreign laborers or they will immediately take advantage of him, but an occasional bit of "jollying" goes a long way toward keeping the men on edge, while at the same time they forget their hardships; and then when the foreman's back is turned towards the men, as it occasionally must be, there is far more work done than if the men were working for a man they have a constant hatred for.

A logical way, therefore, to go about reformation, it seems to me, is to begin by offering better wages and more inviting living quarters and accommodations and thus force the labor agencies (if we must tolerate them) to furnish better men. The interpreter should be abolished and a portion of the wages hertofore paid to him should be added to the foreman's pay in order to secure first-class supervision. This foreman should be held responsible for results only and should be free to adopt his own method of handling the men and the work.

Competent laborers, competent supervision and satisfactory living conditions, these produce results for contractors —why not for railways?

With The Manufacturers

EXHIBIT OF THE NATIONAL RAIILWAY APPLIANCE ASSOCIATION.

The annual exhibition of the National Railway Appliances Association will be held in Chicago, March 15th to 21st, inclusive. Both the Coliseum and the First Regiment Armory have been leased to provide for the constantly increasing demand for space.

From the large number of exhibitors listed and the interest shown, it is certain that the exhibit will be an interesting and instructive one.

Following is a list of the exhibitors:

The Adams & Westlake Co., 319 W. Ontario St., Chicago.
Ajax Forge Co., 2503 Blue Island Ave., Chicago.
American Guard Rail Fastener Co., Philadelphia, Pa.
American Hoist & Derrick Co., Fisher Bldg., Chicago.
American Lock Nut Co., 111 W. Jackson Blvd., Chicago.
American Rolling Mill Co., Middletown, Ohio.
American Steel & Wire Co., 72 W. Adams St., Chicago.
American Valve & Meter Co., Cincinnati, Ohio.
American Vulcanized Fibre Co., 307 Lewis Bldg., Pittsburg.
Asphalt Ready Roofing Co., 90 Church St., New York City.
Associated Mfgs. Co., Waterloo, Iowa.
Atlas Preservative Co. of America, 95 Liberty St., New York.
F. A. Barbey, Essex Bldg., Boston, Mass.
Barrett Mfg. Co., 17 Battery Place, New York City.
Beaver Dam Malleable Iron Co., Beaver Dam, Wis.
Louis Blessing, Jackson, Mich.
Blocki-Brennan Refining Co., 11 No. La Salle St., Chicago.
S. F. Bowser & Co., Ft. Wayne, Ind.
L. S. Brach Supply Co., 143 Liberty St., New York City.
Bryant Zinc Co., 600 Orleans St., Chicago.
Bucyrus Co., So. Milwaukee, Wis.
The Buda Co., Railway Exchange, Chicago.
Buyers Index Co., 445 Plymouth Place, Chicago.
The Philip Carey Co., Lockland, Cincinnati, Ohio.
Carnegie Steel Co., Pittsburgh, Pa.
Geo. B. Carpenter & Co., Wells & Michigan Sts., Chicago.
Chicago Bridge & Iron Works, 105th and Throop Sts., Chicago.
Chicago Pneumatic Tool Co., Fisher Bldg., Chicago.
Chicago Railway Equipment Co., McCormick Bldg., Chicago.
Chicago Steel Railway Tie Co., Railway Exchange, Chicago.
Cleveland Frog & Crossing Co., Cleveland, Ohio.
Clyde Iron Works, Duluth, Minn.
Commercial Acetylene Ry. Lgt. & Sig. Co., Chicago.
Concrete Steel Co., Monadnock Block, Chicago.
Conley Frog & Switch Co., Memphis, Tenn.
Cook Railway Signal Co., Gas & Electric Bldg., Denver, Colo.
Cook's Standard Tool Co., Kalamazoo, Mich.
Crerar Adams & Co., 259 E. Ohio St., Chicago.
Curtain Supply Co., 320 W. Ohio St., Chicago.
D. & A. Post Mold Co., Three Rivers, Mich.
Des Moines Bridge & Iron Works, Curry Bldg., Pittsburgh.
Detroit Graphite Co., Detroit, Mich.
Paul Dickinson, Inc., Security Bldg., Chicago.
Dieter Nut Co., 84 Williams St., New York City.
Eugene Dietzgen Co., 166 W. Monroe St., Chicago.
Dilworth, Porter & Co., Pittsburgh, Pa.
Joseph Dixon Crucible Co., Monadnock Block, Chicago.
The G. Drouve Co., Bridgeport, Conn.
Duplex Metals Co., 30 Church St., New York City.
E. D. E. Co., Railway Exchange, Chicago.
Eastern Granite Roofing Co., 17 Battery Place, New York.
Thomas A. Edison, Inc., Orange, N. J.
Edison Storage Battery Co., Orange, N. J.

Electric Storage Battery Co., Marquette Bldg., Chicago.
Fairbanks, Morse & Co., 900 So. Wabash Ave., Chicago.
Fairmont Machine Co., Fairmont, Minn.
Federal Signal Co., Monadnock Block, Chicago.
Frank M. Foster, 515 W. First Ave., Columbus, O.
Franklin Mfg. Co., Railway Exchange, Chicago, Ill.
General Electric Co., Schenectady, N. Y.
General Railway Signal Co., Rochester, N. Y.
Gordon Primary Battery Co., 50 Church St., New York.
Hall Switch & Signal Co., Peoples Gas Bldg., Chicago.
Hart Steel Co., Elyria, Ohio.
Hayes Track Appliance Co., Richmond, Ind.
Hobart-Allfree Co., Old Colony Bldg., Chicago.
Hubbard & Co., Pittsburgh, Pa.
Indianapolis Switch & Frog Co., Springfield, Ohio.
Inland Steel Co., First National Bank Bldg., Chicago.
International Harvester Co., Harvester Bldg., Chicago.
International Inter-Locking Rail Joint Mfg. Co., Chicago.
International Steel Tie Co., Hippodrome Bldg., Cleveland.
Iowa Gate Co., Cedar Falls, Iowa.
H. W. Johns-Manville Co., Madison Ave. and 41st St., New York.
O. F. Jordan Co., McCormick Bldg., Chicago.
Joyce-Cridland Co., Dayton, Ohio.
Kalamazoo Railway Supply Co., Kalamazoo, Mich.
Kelly, Derby Co., Fisher Bldg., Chicago.
The Kennicott Co., Corn Exchange Bank Bldg., Chicago.
Kerite Insulated Wire & Cable Co., 30 Church St., New York.
Keuffel & Esser Co., 68 W. Madison St., Chicago.
Keystone Driller Co., Monadnock Block, Chicago.
Lackawanna Steel Co., 72 W. Adams St., Chicago.
The Lehon Co., West 45th St. and Western Ave., Chicago.
Lidgerwood Mfg. Co., Fisher Bldg., Chicago.
Lorain Steel Co., Monadnock Block, Chicago.
Lufkin Rule Co., Saginaw, Mich.
Luitwieler Pumping Engine Co., Rochester, N. Y.
David Lupton's Sons Co., Allegheny and Tulip Sts., Philadelphia.
MacRae's Ry. & Supplymen's Mutual Cat. Co., Ry. Exch., Chicago.
C. F. Massey Co., Peoples' Gas Bldg., Chicago.
McFarlane Mfg. Co., St. Paul, Minn.
McGraw Publishing Co., 239 W. 39th St., New York City.
Morden Frog & Crossing Co., 72 W. Adams St., Chicago.
Burton W. Mudge & Co., Peoples' Gas Bldg., Chicago.
M. W. Supply Co., Real Estate Trust Bldg., Philadelphia, Pa.
National Carbon Co., Cleveland, Ohio.
National Electric Specialty Co., St. Clair Bldg., Toledo, O.
National Lock Washer Co., McCormick Bldg., Chicago.
National Malleable Castings Co., 25th Pl. and Rockwell St., Chicago.
Geo. P. Nichols & Bro., Old Colony Bldg., Chicago.
Northey-Simmen Signal Co., Ltd., Traction Term., Indianapolis, Ind.
Northwestern Construction Co., 50 Church St., New York.
Ogle Construction Co., 332 So. Michigan Ave., Chicago.
Ohio Post Mold Co., Nicholas Bldg., Toledo, Ohio.
Okonite Co., 253 Broadway, New York, N. Y.
O'Malley-Beare Valve Co., 333 Railway Exchange, Chicago.
Spencer Otis Co., Railway Exchange, Chicago.
The P. & M. Co., Railway Exchange, Chicago.
W. W. Patterson Co., Pittsburgh, Pa.
C. F. Pease Co., 167 W. Adams St., Chicago.
The Pennsylvania Steel Co., McCormick Bldg., Chicago.
Pocket List of R. R. Officials, 75 Church St., New York.
Positive Rail Anchor Co., Marion, Ind.
Potter-Winslow Co., Peoples' Gas Bldg., Chiacgo.
Protective Signal Mfg. Co., 1421 18th St., Denver, Colo.
The Q. & C. Co., 90 West St., New York City.
Rail Joint Co., 185 Madison Ave., New York City.
Railroad Supply Co., 203 So. Dearborn St., Chicago.
Railway List Co., Manhattan Bldg., Chicago.
Railway Review, Ellsworth Bldg., Chicago.
Ramapo Iron Works, Hillburn, N. Y.
Reliance Mfg. Co., Massillon, Ohio.
Remington Oil Engine Co., 120 Broad St., New York City.
Richards-Wilcox Mfg. Co., Aurora, Ill.
Roberts & Schaefer Co., McCormick Bldg., Chicago.
Sanitary Bunk Co., 2460 N. Alabama St., Indianapolis, Ind.
Sellers Mfg. Co., McCormick Bldg., Chicago.
Signal Accessories Co., 30 Church St., New York City.
Simmons-Boardman Publishing Co., 83 Fulton St., New York.
T. W. Snow Construction Co., Ellsworth Bldg., Chicago.
Southern Railway Supply Co., 113 N. Second St., St. Louis, Mo.
Standard Asphalt & Rubber Co., 137 So. La Salle St., Chicago.
Standard Underground Cable Co., Pittsburgh, Pa.
Stark Rolling Mill Co., Canton, O.
Steel Ry. Tie & Appliance Co., Denver, Colo.
Templeton, Kenly & Co., Ltd., 1016 So. 56th Ave., Chicago.
Titanium Alloy Mfg. Co., Niagara Falls, N. Y.
Toledo Pipe Threading Machine Co., Toledo, Ohio.
Union Draft Gear Co., McCormick Bldg., Chicago.
Union Iron Works, Hoboken, N. J.
Union Switch & Signal Co., Peoples' Gas Bldg., Chicago.
U. S. Wind Engine & Pump Co., Batavia, Ill.
Universal Metallic Tie Co., Salt Lake City, Utah.
Verona Tool Works, Karpen Bldg., Chicago.
Western Electric Co., 500 So. Clinton St., Chicago.
Wm. Wharton, Jr., & Co., Inc., Philadelphia, Pa.
White Enamel Refrigerator Co., Railway Exchange, Chicago.
Winans Improved Patent Rail Joint Co., Portland, Ore.
Wolfe Brush Co., 1805 Beaver Ave., Pittsburgh, Pa.
Wyoming Shovel Works, Wyoming, Pa.

The Atchison, Topeka & Santa Fe, it is reported, will extend its Sterling City branch from that place to Pecos, Tex., a distance of 146 miles. It is said the new work will be started the early part of next year. This proposed extension will connect at Pecos with the Pecos Valley of the Santa Fe System.

The Birmingham & Southeastern is said to have made overtures to the citizens of Tuskeegee, Ala., looking toward the construction of a branch into that city. It is probable that this branch, if built, would later be extended on to Dadeville in Tallapoosa county, Ala.

The Canada & Gulf Terminal has work under way on the extension from Matane, Que., east to Gaspe Basin, about 160 miles, that the surveys are all completed.

The Canadian Pacific, it is reported, will have new work on the western division the present year including finishing up of some 300 miles of new line and building 500 miles additional. The plans include also the building of a tunnel 5 miles long in the Selkirk mountains.

The Memphis, Dallas & Gulf, it is reported, will start work immediately upon the previously announced extension from near Murfreesboro to Hot Springs, Ark., and soon afterwards upon an extension to Pine Bluff, Ark., a distance of about 100 miles.

The Mobile & Eastern Shore is being organized in Alabama, to build from Montrose Park, Ala., south to a point below Point Clear, about 20 miles.

The Northern Pacific, it is said, has started work on an extension of the Clark's Fork branch from Bridger, Mont., south to Chance, about 20 miles.

VERONA TOOLS AND NUT LOCKS.

Track tools manufactured by the Verona Tool Works, of Pittsburgh, Pa., have been maintained at a high standard of excellency, regardless of the fact that there are many makes of lower quality tools which are being placed on the market to meet the demands of railways for low first cost.

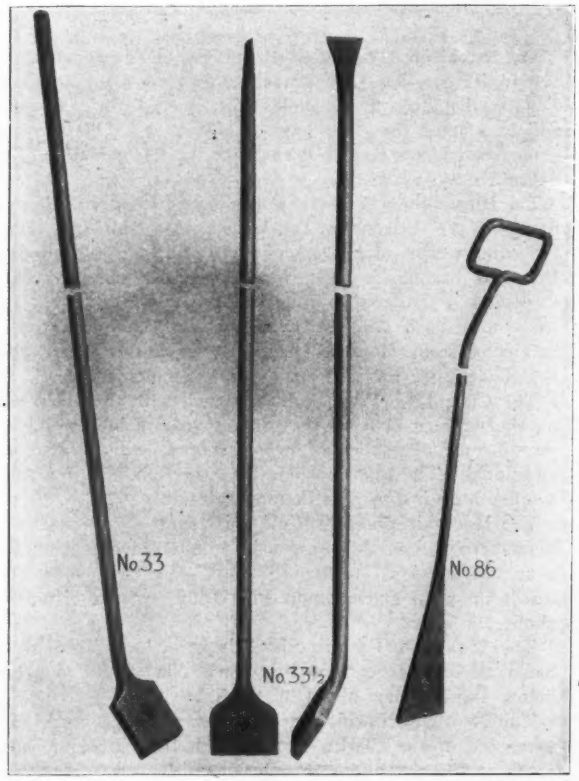
Track tools of good and poor quality are, to the superficial examiner, just "tools," and the manufacturer's trademark should be a guarantee. It is not surprising, however, that the railways can get what they pay for, no matter how little they wish to pay. Poor tools can be purchased, but less work is usually the result, and higher expense for track up-keep is the natural sequence.

The plant of the Verona Tool Works is devoted exclusively to the production of track tools and spring nut locks. The plant is operated principally on the piece-work principle, but with a rigid system of inspection. This inspection is such that the men are very careful to throw out defective steel before much, or any work is done on it, as such work would be wasted. The piece-work rate is never reduced, with the result that many of the men make from $8 to $10 per day.

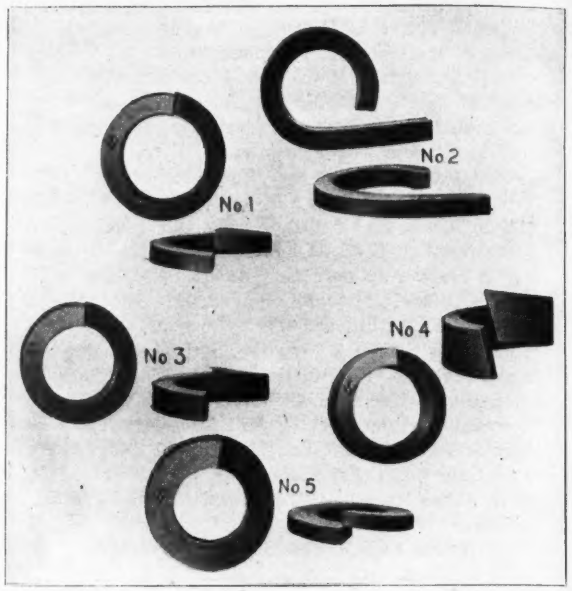
Automatic machines perform many of the operations, but where expert work is required, such as in the forging and tempering, the old men are kept in service as long as possible and pensioned when they are no longer useful.

Every heat of steel entering the plant is analyzed by a chemist and its component elements are not allowed to vary in proportion, except within a narrow margin. The steel used in the spring nut locks contains the elements in the following proportion, as averaged for the year:

Carbon	.99
Phosphorus	.0283
Sulphur	.0307
Silicon	.0175
Manganese	.416



Verona Tamping Bars.

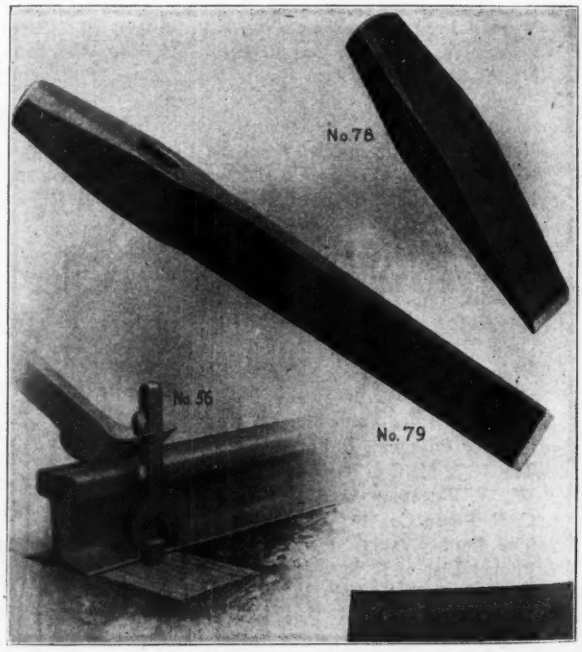


Types of Verona Spring Nut Locks.

Upon the maintenance of these specifications depends the elimination of difficulties experienced by many railways a few years ago in breakage, and soft springs taking solid sets. Each Verona spring nut lock is tested under a special steam machine which closes them solidly.

For the tools, steel of varied composition, according to the class of work for which they are designed, is used. The cutting tools are of crucible, while dull edge striking and tamping tools are of open hearth steel. All are carefully tempered and are then severely tested out by hand. It was observed that one chisel out of about 100 was cast aside as defective by the tester after each had been used with several blows in cutting a Bessemer rail.

In forging tools, specially designed furnaces are used, operated by men who have become experienced in the one



Verona Spike Puller and Track Chisels.

class of tools they turn out. The forming machines are, of course, all of special design. This places shop production at its minimum cost and allows the widest margin in the selling price to apply on material and workmanship.

INTERLOCKING RAIL JOINT.

The illustrations herewith show an interlocking rail joint which is designed to entirely eliminate all joint fastenings —angle bars, joint plates and bolts. Engineers and track men have been studying and experimenting on this problem for years. The ordinary joint has been conceded to be the weakest point in the track and that is the reason for the amount of study, money and time spent in trying to improve the joint.

The street railways, in general, long ago resorted to welding their track into continuous rails. This method has proven practical only in those cases where the base and web of the rail are entirely buried in the pavement. The pavement acts as a temperature regulator, greatly lowering the temperature of the rail in summer, and to some extent

Rails Ready for Locking.

holding and regulating the temperature in the winter time. It is undoubtedly true that very high compressive stresses are caused in the summer, stresses which could not be taken care of on ordinary steam railway track. The tension in the rails is not so serious, although street railway rails sometimes break in two and pull apart in the winter.

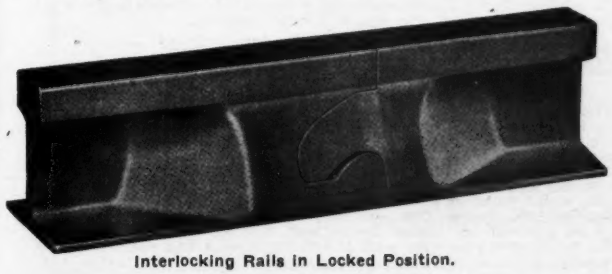
The Interlocking rail joint provides a sufficient space for expansion and contraction under extreme conditions, which is a prime requisite for any connection for steam railway work.

The section at the joint is greatly increased, as shown in the illustrations herewith. This increase in section is claimed to sufficiently reinforce the rail to compensate for the metal stamped out of the web for inserting the tongue of the abutting rail.

This joint, designed to do away entirely with rail fastenings, not only saves the investment in these fastenings, but also eliminates all bolt tightening, the cost of which is realized by all track men. The increased cost of the rails with this joint, it is stated, is more than offset by the saving in cost of ordinary rail joint fastenings.

The vertical slot and key in the joint is designed to make a close fit and keep the abutting rails in perfect alignment with each other at the joint.

In joining the rails when laying track, it is necessary to raise the rails 8 inches, and the joint is unlocked by raising the rail the same distance.



Interlocking Rails in Locked Position.

The rail joint described herein is controlled by the International Inter-Locking Rail Joint Manufacturing Co., 1200 Karpen Bldg., Chicago. This concern has received orders from several large steam and interurban railways for rails equipped with this joint.

PANAMA CANAL SPREADERS.

Editor *Railway Engineering & Maintenance of Way*: I understand the Isthmian Canal Commission has commenced to offer for sale the 21 Mann-McCann and Mann earth spreaders that we built for them and a lot of repair parts for the same. In justice to the bidders, and ourselves, I wish to state that these are specially built machines and that their extreme clearance renders it impossible to transport or use them on any roads on this Continent. The repair parts are for these machines alone, and cannot be used on any other machine.

I hope you will place these facts before your readers.

(Signed) O. C. Mann.

New Literature

A booklet has recently been issued by the W. F. Goltra Tie Co., Cleveland, O., describing the recently patented Goltra process of tie preservation. The book, which is a very comprehensive treatise, gives a number of extracts from the technical press, from proceedings of Technical societies, etc. The process consists of preliminary steaming as soon as timber is cut, air seasoning for a limited period, and kiln drying and heating just previous to the injection of the preservative.

A second bulletin issued by this concern gives some comments which have been made on the process. This booklet contains some additions to data given in the former book, notably chapters on the "Mechanical Life of Ties," and "Essentials for Effective Work in Timber Treating."

Industrial Notes

The annual convention of the sales and factory organizations of the Chicago Pneumatic Tool Co. was held at the show rooms of the company, at 1337 South Michigan avenue, Chicago, on January 9, 10 and 11.

The name of the Chicago Tie & Timber Treating Co of Waukegan, Ill., has been changed to the Chicago Creosoting Co.

William N. Thornburgh has been appointed general sales manager of the Standard Asphalt & Rubber Co. He will have jurisdiction over water-proofing, engineering, mastic floor and paving departments.

J. R. McKee, O. D. Young and Anson W. Burchard, all of New York, have been elected vice-presidents of the General Electric Co.

The W. F. Goltra Tie Co., Maysville, Ky., plans the establishing of a tie-creosoting plant.

Rex S. Gay, formerly representative of the Ajax Forge Co., at Chicago, will, after March first, be connected with the Verona Tool Works, as assistant sales agent. His headquarters will be at Chicago.

Edward W. Hodgkins has been appointed a representative of Guilford S. Wood, with office at Chicago.

The Milwaukee and West Allis properties of the Allis-Chalmers Co. were sold by Commissioner Hazelton on February 3, to J. H. McClement of New York, chairman of the reorganization committee, for $2,250,000.

Recent Engineering and Maintenance of Way Patents

SWITCH STAND.

1,051,401—N. O. Goldsmith, assignor to Weir Frog Co., Norwood, O.

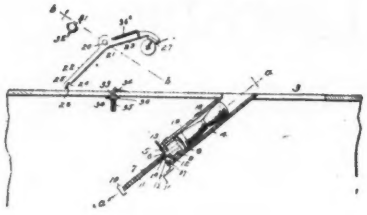
This switch stand has a crank shaft formed with a goose-neck at its lower end, having an upwardly extending crank pin, an eccentric bushing mounted thereon, with means for adjusting and locking the bushing in any desired position, a switch lever with locking devices therefor disposed on opposite sides of the stand to provide a throw of one hundred and eighty degrees for the lever between locking positions, with the goose-neck crank disposed at right angles to the track in each of the locking positions of the switch level; and a connecting rod to the switch rails journaled on the bushing, with the connecting rod and crank shaft formed to permit a dead center for each locking position of the switch lever.

FOOT GUARD.

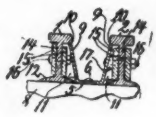
1,051,423—L. F. Learman, St. Paul, Minn.

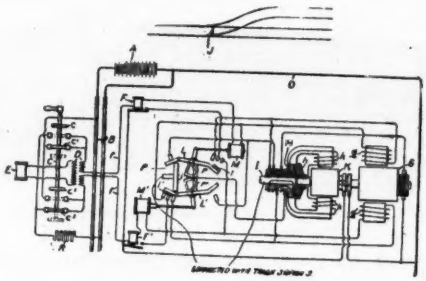
The combination with a rail joint having fish plates and bolts therethrough, of a guard plate covering one of the fish-plates and having holes for the bolts by which the fish-plate is secured, and angular ends fitting between the upper and lower flanges of the rail and bearing against the center web of the rail when the upper edge of the plate fits up under the edge of the upper flange or tread of the rail, and bushings on the bolts between the fish plate and the guard plate.

1,051,676

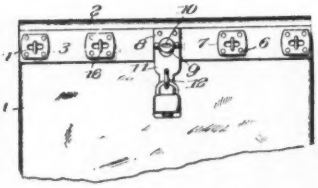


1,051,423





1,051,708.



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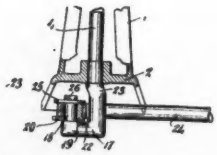
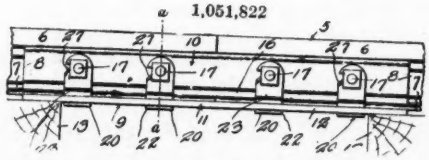


1,051,822



SWITCH CONTROL MECHANISM.

1,051,557—F. J. Corey, Schenectady, assignor to the Union Switch & Signal Co., Swissville, N. Y.

In combination, an electric motor, control-wires therefor, a traffic-controlling device, a small electric generator having its elements mechanically connected to the motor and to the device respectively, means for connecting the generator armature in series with one of the motor control wires, a magnetic clutch for connecting the motor to the device to drive it, means controlled by the movement of the device to a predetermined position for de-energizing the clutch, and an electro-magnetic device responsive to current produced in the control-wire by the generator but not to the motor current.

WOOD PRESERVING METHOD.

1,051,596—J. W. Illingworth, New York City.

The process for treating green woods containing resins and acids consisting in cutting the wood in the desired lengths and then removing the bark therefrom, then immersing the wood in water at a temperature considerably below the boiling point until a starchy exudation appears on the surface thereof, then removing this starchy substance and drying the wood in the open air, then sawing the wood into lumber pieces, then immersing the lumber pieces in lime water to combine with and to fix the remaining gums and acids in the wood and to impregnate the pores and ducts with lime, and then drying the lumber in open air.

SIGNAL TORPEDO.

1,051,666—W. C. Beckwitch, Fostoria, O.

A railway signal torpedo, comprising a case composed of sheets of soft metal and paper formed into a receptacle by wrapping them together and having the paper sheet extend beyond the metal sufficiently to form an outside paper wrapper cemented paper to paper, an explosive compound within the case, the same projecting beyond the compound and closely compressed to form extending rail engaging members.

MAIL BAG CATCHER AND DELIVERER.

1,051,676—S. E. Brown, Kenosha, Wis.

A mail bag projecting chute having a plunger movable longitudinally therein and provided with rearwardly extending rack rod, a spring to project the plunger, a shaft having a crank handle and also provided with a pinion to engage the rack bar of the plunger and a bearing for the shaft in which the latter is mounted for pivotal movement to enable the pinion to be engaged with and disengaged from the plunger rack bar.

MAIL POUCH FASTENER.

1,051,708—A. T. Doyle, Union, Ore.

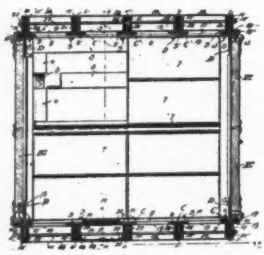
A mail pouch fastener comprising a mounting plate carried by the bag, a plurality of levers pivoted on the plate, flexible connecting members engaged with opposite ends of the rock levers, turn buttons connected to the rock levers, a slotted plate carried by the flap of the pouch, a slotted block journaled in the plate, a hasp pivoted to the block and adapted to rotate the same in the plate for turning all of the buttons simultaneously, a staple mounting plate, and a staple carried thereby adapted to be engaged by the hasp.

RAIL JOINT.

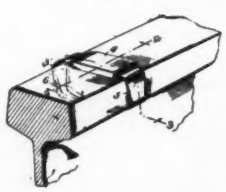
1,051,822—J. R. Prinz, Shawnee, Okla.

The combination in a rail joint with the meeting ends of a pair of rails, of fish plates engaging the opposite sides of the rails, a base plate formed upon the lower edge of one fish plate and extending beneath the rails and projecting beyond the opposite sides of the rails, the base plate having a slot formed therein adjacent the edge of the rail, a fastening bolt passing through one of the rails and fish plates, a plate extending through the slot, the plate being offset at one end to engage the under side of the base plate, the plate being curved to conform to the curvature of the rail and contact with the lower edge of the adjacent fish plate, and an outwardly slanting spring extension formed upon the plate, the extension having an opening formed therein for receiving the bolt, a finger struck outwardly from the spring extension adjacent the opening and a nut threaded upon the bolt for co-operation with the spring extension and finger formed thereon.

1,051,842



1,051,666



FIRE PROOF KNOCK-DOWN HOUSE.

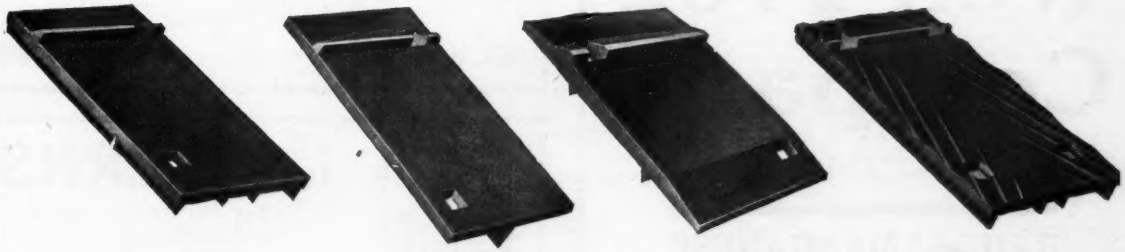
1,051,842—J. Lochner, assignor to National Housing Co., Milwaukee.

A fire proof knock-down house comprising a separable skeleton frame having webbed side and end sills, end and intermediate ribs having vertically disposed side and angularly disposed roof joist sections, means for securing the lower ends of the side joist rib section to the webs of the sills, a ridge-beam detachably secured to the abutting ridge ends of the roof joist sections, inner metallic wall and ceiling plates detachably fitted between the frame ribs, outer metallic sheathing and roofing panels detachably fitted between the frame ribs and spaced from the wall and ceiling plates whereby air spaces are formed, tie-rods in connection with the series of frame-ribs, wall and ceiling plates and sheathing and ceiling panels, a floor supported upon the sills of the frame, and end closures carried by the frame end ribs.

SHOULDER TIE PLATES

ROLLED FROM OPEN HEARTH STEEL BILLETS

LONGITUDINAL AND TRANSVERSE FLANGES



STYLE A STYLE B STYLE O STYLE D

No more satisfactory plates can be placed under rails than the types represented above

(Our Catalog describes 20 different styles of plates)

Manhattan Compromise Rail Joints

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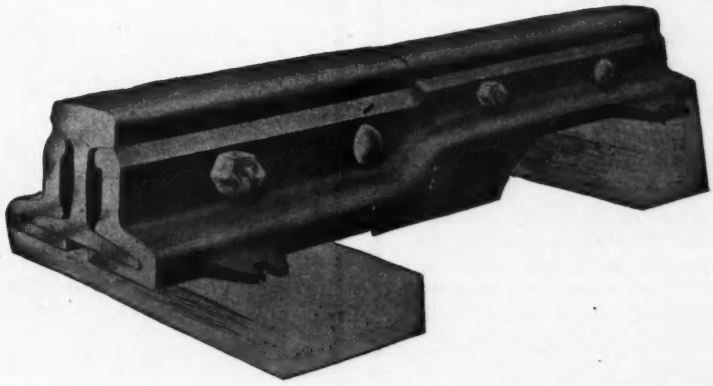

Base supporting, centrally reinforced joint having an approximate equal distribution of metal for each rail. Our girder construction makes it stronger at the center than any other known type of construction.

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CHICAGO—G. S. Wood, Great Northern Building
SAN FRANCISCO—Western Ry. & Mill Supply Co., Monadnock Bldg.
RICHMOND, VA.—J. B. Kirtley, Mutual Building

For Rail Joints—ST. LOUIS—W. H. Dayton, Security Building

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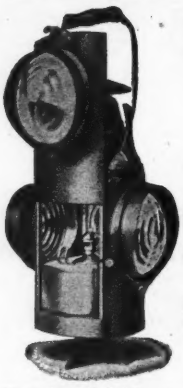

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MARKER, STATION, Etc.

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Exceptional facilities for athletic sports and all forms of outdoor life under the supervision of the Masters.

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A Princeton Professor writes: "Some of our finest Princeton students were former pupils of yours." For illustrated catalog, address

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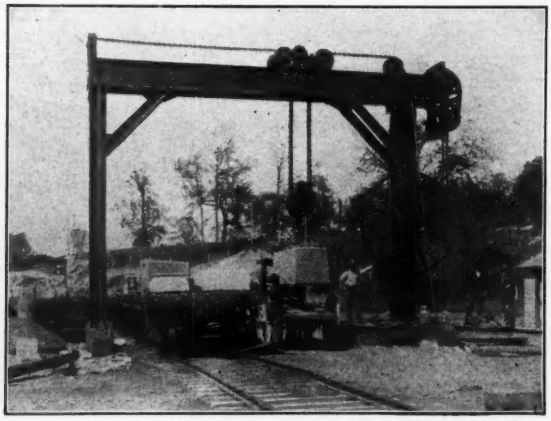

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is an inexpensive and durable machine for handling all heavy loads from car or wagon with just one or two men. Being equipped with safety appliances, it practically eliminates all danger to the men.

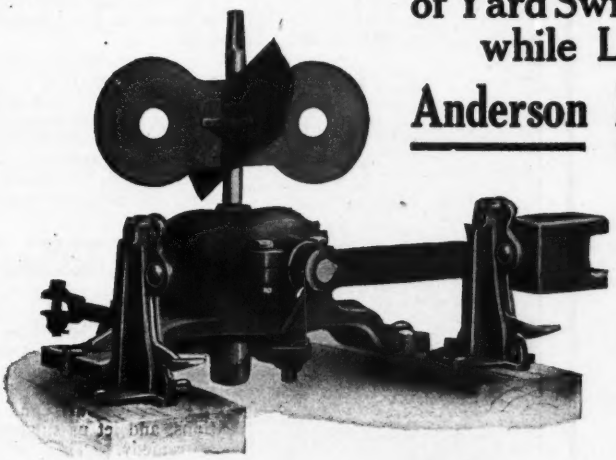
Write for our new catalog J on bridge cranes.

THE BROWN HOISTING MACHINERY CO.
CLEVELAND, OHIO
New York Pittsburgh Chicago San Francisco

16⅔ CENTS Maximum Maintenance Cost

of Yard Switches that are Run Through while Latched if you use the

Anderson Economy Switch Stand



This stand for yard switches, is provided with a special 3 way crank arm made of malleable iron. This 3 way crank arm is designed that when switch is run through, one of the arms to which the switch is connected will shear off, without damage, to any part of the switch mechanism.

The switch can be quickly placed in order by connecting the rod to one of the other arms. When the three arms are destroyed a new three way crank can be applied. These are furnished at 50 cents each. This feature is not new.

Over 30,000 Economy switch stands with this special 3 way crank, in service on many railroads.

Nonbreakable cranks are furnished for main line switches.

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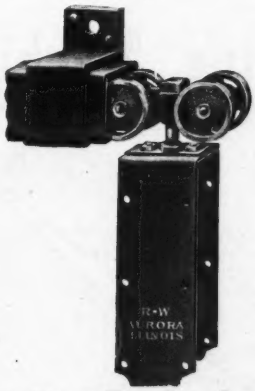

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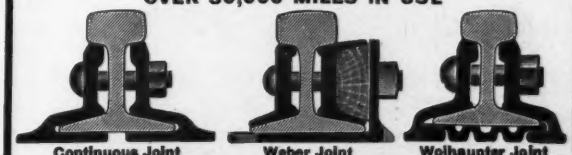

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Over one-third more cars moved and 1600 tons less coal consumed in doing it should appeal forcibly to every railroad man whose locomotives traverse bad water districts.

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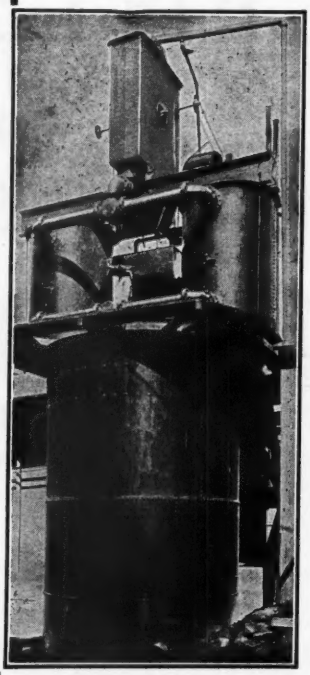

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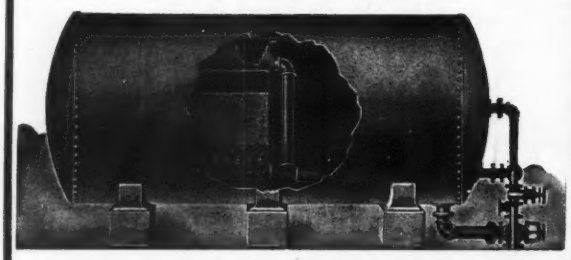

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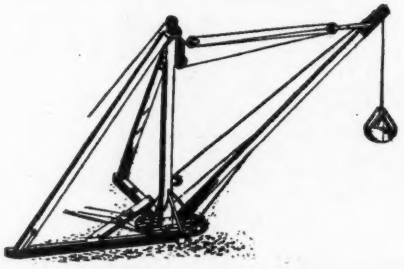

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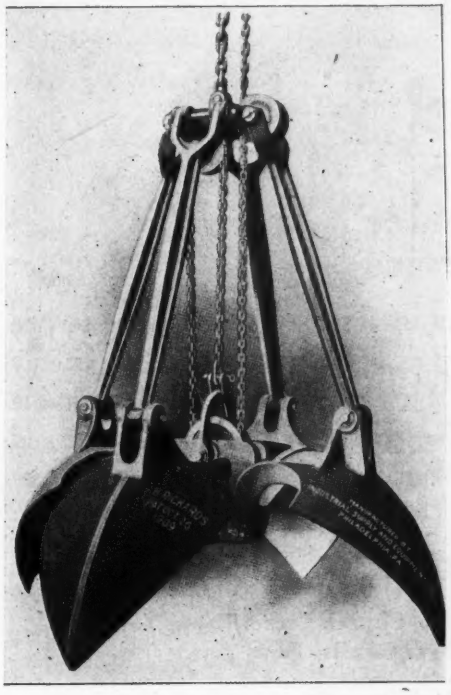

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	If Not Over	Capacity.	Throat Opening	Wt. Each
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Type B for rail up to 80 lbs.	5 inches high	80 Ton Locomotive	2½ ins.	110
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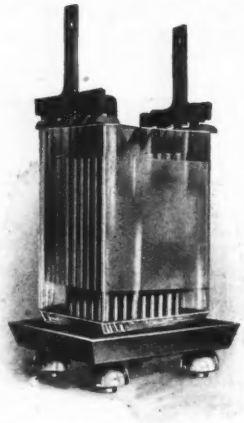

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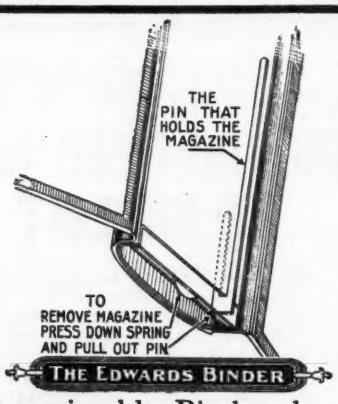

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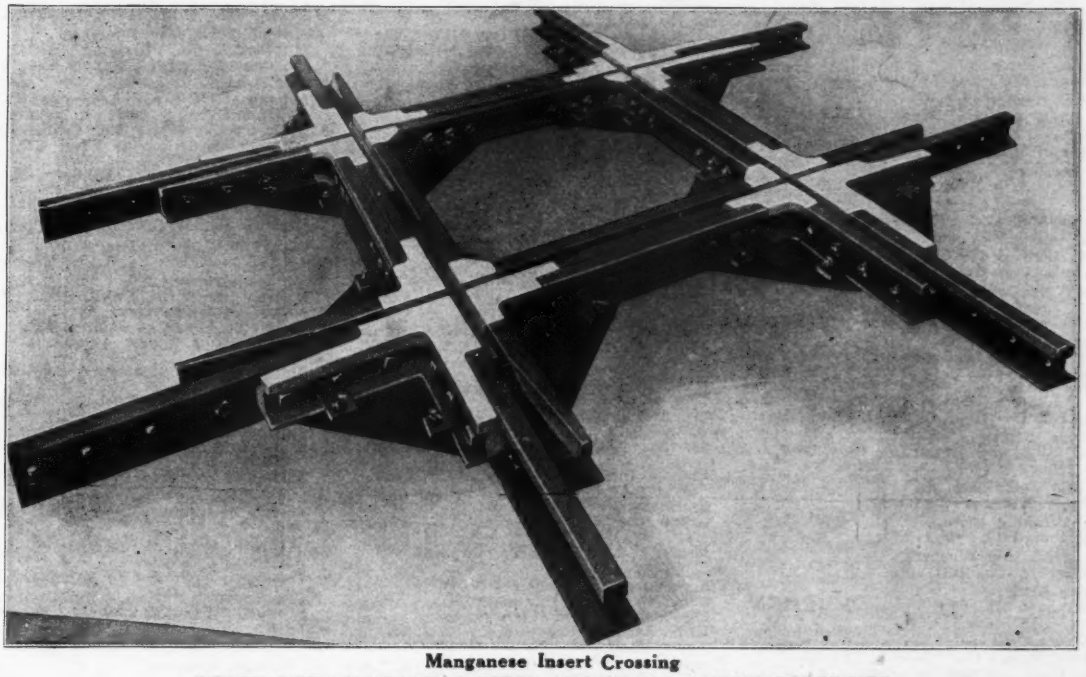

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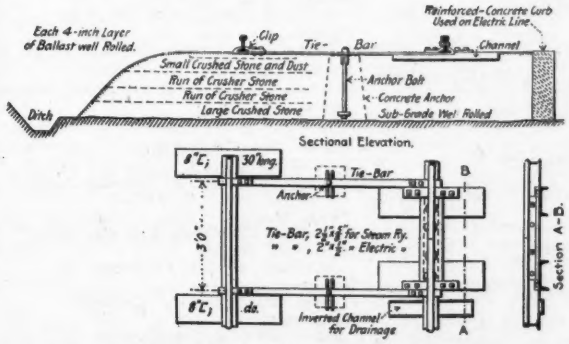
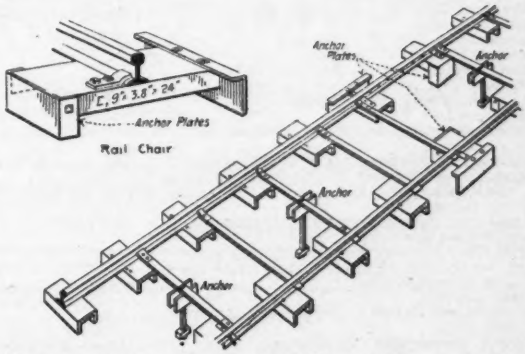


Track Construction with a watertight bed of rolled stone ballast.



Track Construction for very heavy traffic, used in connection with heavily rolled bed of broken stone.

A reinforced compacted monolithic bed or permanent way is a support for the rails and rail chairs. The chairs may be considered under the head of tie plates. My bed represents both the ballast and wooden ties combined. A bed constructed on my plan will answer every condition required of both, and more too. The alignment is permanently maintained, as well as surface and gage. It will admit of the use of anti-creeper appliances. There is a scrapping value in the steel after being used. The bed will not settle out of sight in the soft ground and be lost. It is practically water-tight, and has a tendency to prevent the settlement of embankments. It can be constructed to carry wheel loads of 30,000 lbs. each at maximum speeds.

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Ramapo Iron Works, Hillburn, N. Y.
Weir Frog Co., Cincinnati.

Switchboard Adjusters.
Weir Frog Co., Cincinnati.

Tank Cars.
Wm. Graver Tank Works, E. Chicago, Ind.

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Wm. Graver Tank Works, E. Chicago, Ind.
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Hubbard & Co., Pittsburg.

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Track Necessities Co., Chicago.

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Hart Steel Co., Elyria, O.

Tie Surfacer.
Track Necessities Co., Chicago.

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Track Necessities Co., Chicago.
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Track Necessities Co., Chicago.
Verona Tool Works, Pittsburgh, Pa.
Wyoming Shovel Works, Wyoming, Pa.

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Trolley Brackets.
Electric Ry. & Equip. Co., Cincinnati, O.

Turntable Tractors.
Nichols, Geo. P., & Bro., Chicago.

Turntables.
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Valve Grease, Graphite.
Dixon, Joseph, Crucible Co., Jersey City, N. J.

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Kalamazoo Railway Supply Co., Kalamazoo, Mich.

Ventilating System.
Gale Installation Co., Chicago.

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Hubbard & Co., Pittsburg, Pa.
Coes Wrench Co., Worcester, Mass.
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Lord, Geo. W., & Co., Philadelphia, Pa.

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Gray, Peter, & Sons, Boston.

Water Filters.
Pittsburgh Filter Mfg. Co., Pittsburg, Pa.

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Booth, L. M., Co., Chicago.
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Lord, Geo. W., & Co., Pittsburg, Pa.
Pittsburgh Filter Mfg. Co., Pittsburg, Pa.

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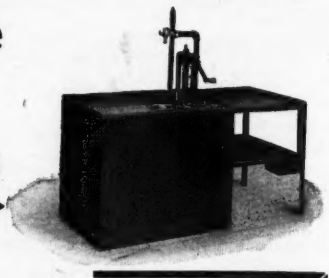

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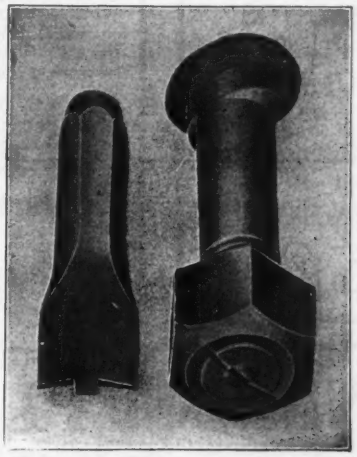

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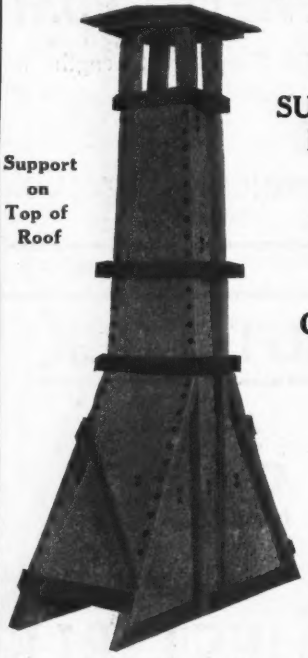

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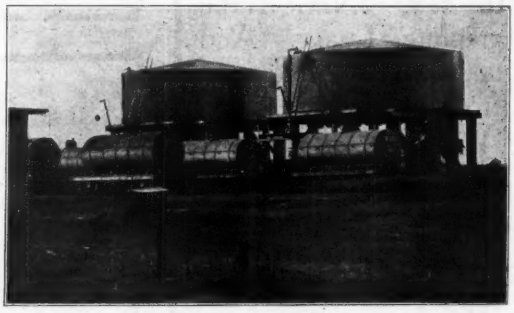

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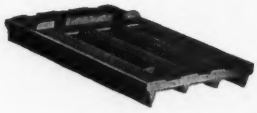

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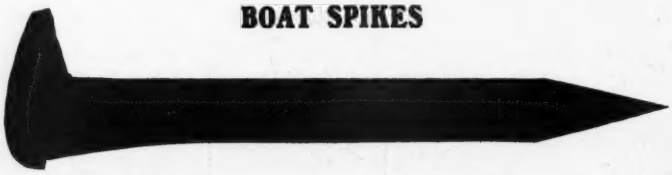

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